INTRODUCTION TO ANTARCTICA

U.S. ANTARCTIC PROJECTS OFFICER

Introduction to Antarctica

This is a revision of a former publication of the same title. It has been prepared to provide general information about Antarctica to those interested by the staff of the

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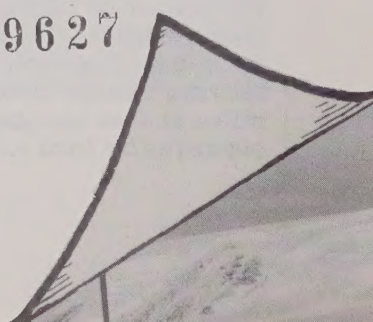
CONTENTS



What Is Antarctica

Antarctica is the continent which surrounds the South Pole. It is a high, ice-covered land nearly twice the size of the United States, surrounded on all sides by oceans.

This south polar region is very different from the Arctic. The land area which surrounds the ice-filled Arctic Ocean is largely tundra and muskeg with low vegetation and many lakes. Only on some of the islands of the Arctic, the largest of which is Greenland, do icecaps like those of the Antarctic occur.

It is believed that over 90 per cent of the world's ice is in the Antarctic. Less than 2 per cent of the almost 5 1/2 million square miles of the continent is ice free.

The icecap is very thick. At one point, scientists have found it to be over 16,000 feet from the surface to the bedrock beneath the ice. The average thickness is about 6,000 feet. The average elevation of Antarctica, the loftiest of all continents, is over 7,000 feet. If the ice should all melt, the oceans would rise between 200 and 300 feet.

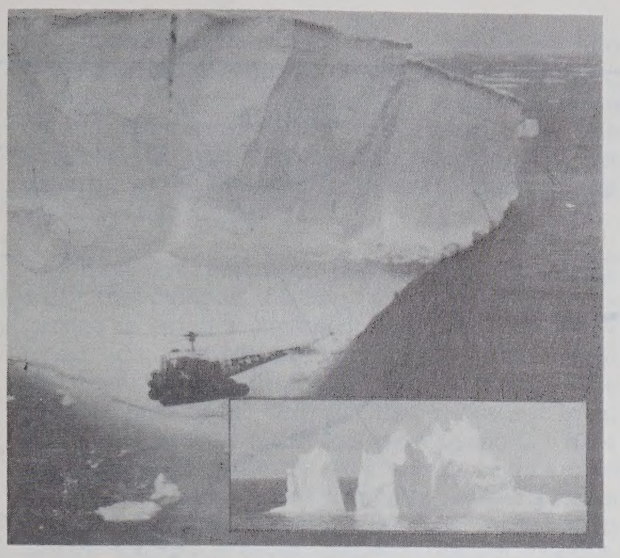
Ice is plastic; it flows. The great weight of the icecap forces the ice relentlessly toward the sea. In some places, it pushes through the mountain valleys great rivers of ice, called glaciers. At others, it feeds into ice shelves which surround much of the continent. Attached to the shore at their inside edge, the ice shelves are afloat and drop in vertical cliffs on their seaward side. The snows of centuries pile up on the ice shelves, filling up the irregularities and presenting finally a smooth, level surface. As only a small portion shows above the surface, the ice shelf may be a thousand feet or more in thickness.

From glacier and ice shelf, great pieces break off and float majestically northward to melt away into the sea. Two types of iceberg are found in the southern oceans: the rough, irregular icebergs of glacial origin, looking like floating cathedrals or ancient castles, and the flat-topped or tabular icebergs, the product of the ice shelves. These latter bergs are frequently so large that early explorers called them ice islands. Tabular icebergs of more than 100 square miles in area have been seen. Some have been sighted as far from Antarctica as 35° South.

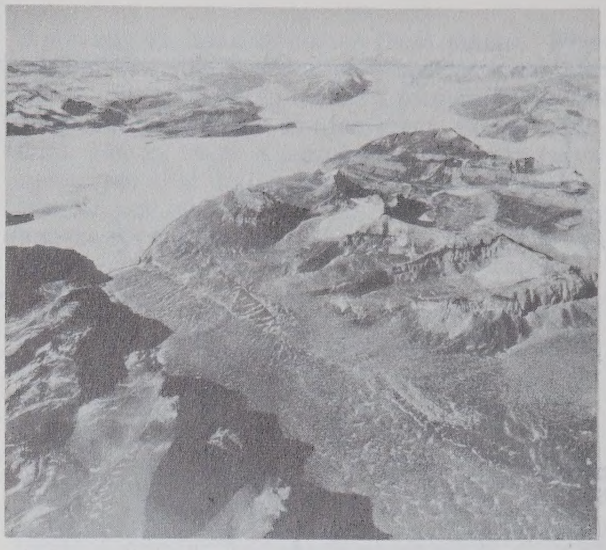
Liv Glacier channeling ice from the polar plateau through the Queen Maud Range and into the Ross Ice Shelf.

View showing flow of ice from the plateau pushing toward the sea.

"Barrier" or edge of the Ross Ice Shelf near Little America. The ice cliffs are more than 100 feet high, and the ice shelf itself is about 600 to 800 feet thick. Bay ice in foreground.



Views of icebergs in the Antarctic.



A dry valley in Victoria Land west of McMurdo.

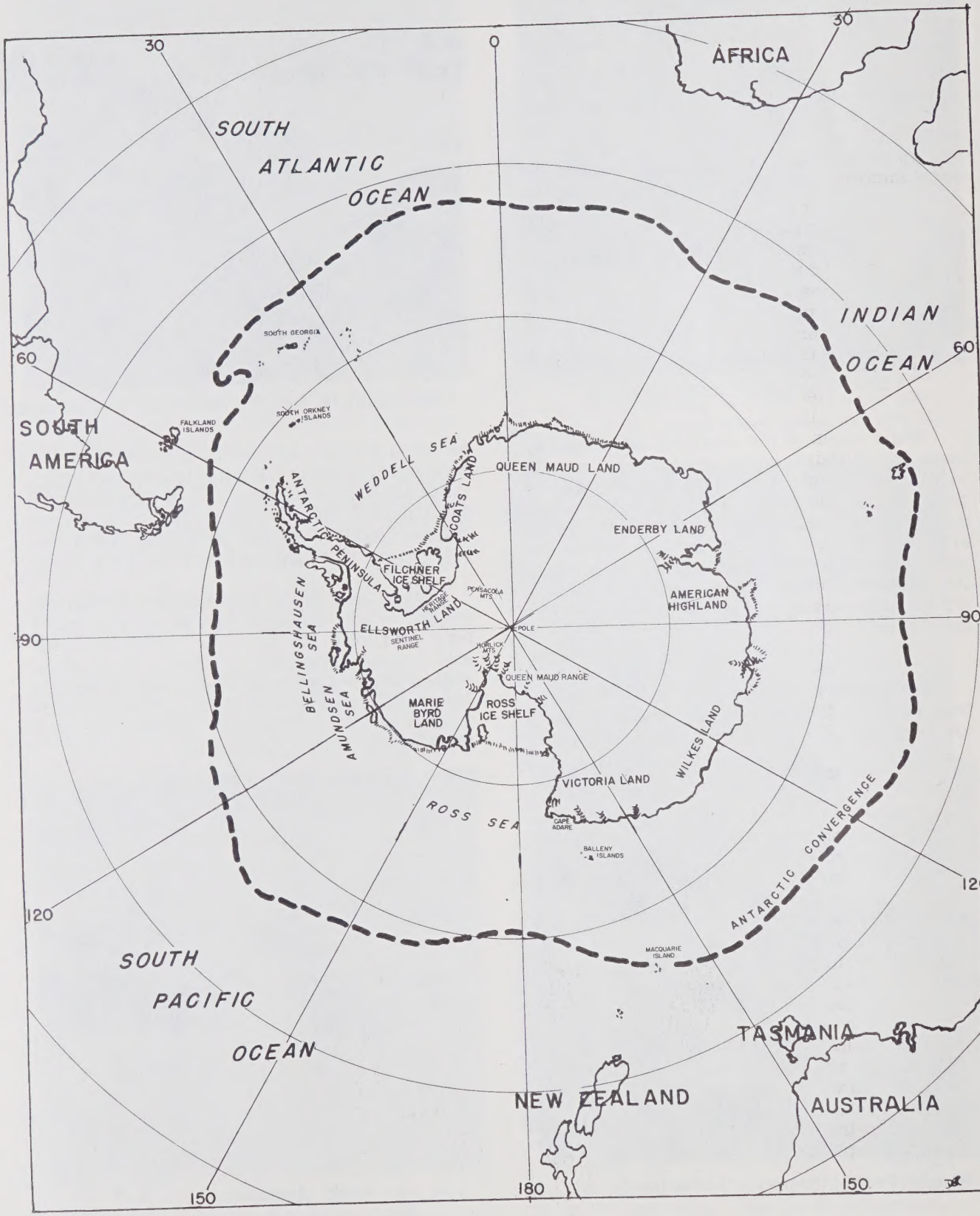
While much of the continent is bounded by these ice cliffs, in other areas steep mountain slopes are found and occasionally beaches and gentle slopes lead inland to the ice plateau. Some mountain chains continue into the interior. Some are covered by the icecap and show above the surface in isolated peaks, called nunataks. Others lie completely hidden beneath the snow and ice and are discoverable only by the use of scientific instruments.

In a few places there are low and level areas free from ice. Areas of this type, called "oases", are found scattered along the coasts. Here, the receding glaciers and the arid climate have left regions of polished rock dotted by brackish lakes. Other ice-free areas are found as "dry valleys." Here, glaciers have receded and only an occasional "alpine" glacier remains. Scattered glacial debris and glacial moraines cover the valley floor.

Since most of the Antarctic lies buried under glacial ice, and not all of that has been carefully examined, the form and structure of the land remain imperfectly known. By careful study of exposed areas and by the use of recently developed techniques to study under-ice topography, scientists of many nations are gradually reducing our area of ignorance.

Wandel Peak on the Antarctic Peninsula.

Nash Mountains.


AFRICA
SOUTH ATLANTIC OCEAN
INDIAN OCEAN
SOUTH AMERICA
SOUTH GEORGIA
FALKLAND ISLANDS
SOUTH ORKNEY ISLANDS
WEDDELL SEA
ANTARCTIC PENINSULA
COATS LAND
QUEEN MAUD LAND
ENDERBY LAND
FILCHNER ICE SHELF
PENSACOLA MTS.
AMERICAN HIGHLAND
ELLSWORTH LAND
SENTINEL RANGE
POLE
HORLICK MTS.
QUEEN MAUD RANGE
BELLINGSHAUSEN SEA
AMUNDSEN SEA
MARIE BYRD LAND
ROSS ICE SHELF
WILKES LAND
VICTORIA LAND
ROSS SEA
CAPE ADARE
BALLENY ISLANDS
ANTARCTIC CONVERGENCE
MACQUARIE ISLAND
SOUTH PACIFIC OCEAN
TASMANIA
NEW ZEALAND
AUSTRALIA
30
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30
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60
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90
120
120
150
180
150

In general, the continent may be divided into two parts, East Antarctica and West Antarctica, divided by one of the world's great mountain chains, the Transantarctic Mountains. The line between the two corresponds roughly, but not exactly, to the division between the Eastern and Western Hemispheres.

East Antarctica is the larger and geologically the older of the two, and is generally regarded as being a crystalline shield of Precambrian age, comparable to the crystalline shield that covers much of the interior of Canada. The greater part of the bedrock lies above sea level and would appear if the ice were to melt. West Antarctica is made up of a series of mountain systems of more recent origin. Among those visible above the icecap are many of volcanic origin, and one of them, towering Mount Erebus, almost 13,000 feet high, is still active, the world's southernmost live volcano. If the ice were to disappear, some of these systems would appear as island archipelagos, separated from one another by arms of the sea. Some scientists have believed that the Ross and Weddell Seas are connected by an ice-filled channel, but this is by no means certain.

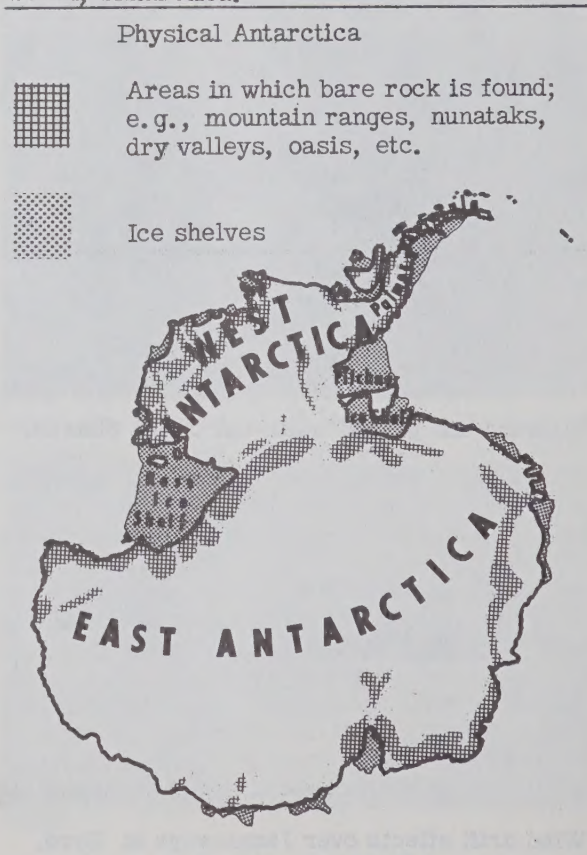
Running northward toward the tip of South America is the Antarctic Peninsula. This mountainous and exceedingly beautiful area is believed to be a continuation of the Andes Mountains that dip under the ocean at Cape Horn. Their course may be followed by a series of rugged islands that protrude from an underwater feature known as the Scotia Ridge.

Each year geologists and geophysicists of many nations go into the field and return with new evidence to fill in the picture. It is gradually becoming evident that the geologic structure of Antarctica is much more complex than previously thought.

Such a large area may be expected to contain minerals. Some 220 have been identified, most of them in very small quantities. Included in the list are most of the world's common minerals, but none so far are found in sufficient abundance to be worth mining. Where 98 per cent of the land is hidden, there may be great riches under the ice, but it will be a long time, if ever, before we can be sure.

Interestingly, men have found coal in many places, most of it, but not all, of a low grade. The presence of coal indicates that Antarctica must once have had a much warmer climate than it now enjoys, for coal comes from plants. Fossilized examples of early vegetation have been found, including tree trunks as much as 24 feet long and over 2 feet in diameter. Some scientists see in them a temperate zone rain forest much like that still existing in our states of Washington and Oregon. A few million years ago—a short time to a geologist—Antarctica was a land of trees and ferns and running water.

Mount Erebus located on Ross Island, McMurdo Sound, Antarctica.



Antarctic Weather

Everybody knows one thing about today's Antarctic weather–it is cold. In fact, Antarctica is the coldest area in the world, on the average, about 30 degrees colder than the Arctic. The lowest temperature ever recorded, 126.9° below zero, Fahrenheit, was reported in 1960 by Russian scientists high on the polar plateau.

During the Antarctic summer from December through March, temperatures along the coast may rise above freezing (32° F.). Inland, on the plateau, they never go that high. In the winter, when the sun withdraws, temperatures drop rapidly and remain far below zero.

Precipitation in most of the Antarctic is very light. The great Antarctic blizzards, about which the explorers so often speak, consist mostly of snow being blown from place to place. The actual amount that falls on the vast central plateau is comparable in its water equivalent to what occurs in desert areas elsewhere in the world.

A third important feature of Antarctic weather is the wind. The wind flows down off the polar plateau sometimes in quiet breezes, but often in roaring blizzards. Blowing a hundred miles an hour, it pins the explorer inside his tent and packs the snow into weird shapes, known as sastrugi, not unlike the sand ripples found on a windy beach, only much larger and more fantastic.

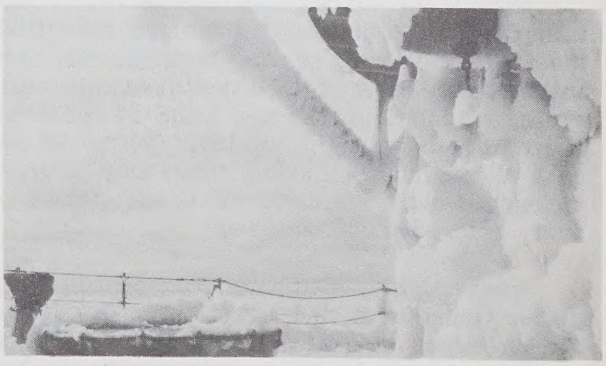
The oceans that surround Antarctica give free sweep to the winds, and southern seas are the world's stormiest. The passage around Cape Horn at the southern tip of South America is famed in fact and story for the severity of its storms. To approach the Antarctic by ship can be a thrilling and exhausting experience.

Thus, Antarctic weather is essentially a combination of cold air, high winds, and blowing snow. The interaction of these three elements provides a pattern unlike any other in the world, a climate which can be most treacherous and forbidding to man.

Blizzard and partial white-out on the plateau.

Storm at Williams Field, McMurdo Sound.

Wind drift effects over Jamesways at Byrd.



Ship icing due to storms in the southern ocean.

Antarctic Plants and Animals

Antarctica is a barren land. It has little animal or plant life, except of the lowest order.

There are only three species of flowering plants—two grasses and an herb. These are found on the Antarctic Peninsula, the section of the continent reaching farthest north. Mosses, lichen, and algae are found in many of the ice-free areas. One rocky area within 300 miles of the South Pole yielded mosses to exploring scientists.

There are no animals, except insects, that can live on the Antarctic Continent. Including arthropods and mites, about 56 species have been identified, the largest of which is a wingless fly, and most of which cannot be seen by naked eye. These minute forms have adapted to the rigorous climate and appear to be the most southerly of living animals.

Life in the sea about Antarctica is another matter. Great amounts of mineral food are found in the polar waters, and upon it microscopic plants thrive. These plants, in turn, are consumed by larger forms. At the end of this chain of life are the whales which feed on red krill, an abundant shrimp-like invertebrate.

Largest of all is the blue whale. A full-grown adult may be over 90 feet long and weigh 150 tons, larger than any other animal known to have lived now or in the past, including prehistoric dinosaurs.

Other whales of only slightly smaller size also exist in large numbers. These great beasts are hunted every year by men from about half-a-dozen nations. They seek principally the oil which is made from whale fat. This oil has many uses, both as a food product and in making special lubricating oil of very fine quality. Other parts of the whale are also used, and practically nothing is wasted.

Modern whaling is a big business. Each expedition is built around a factory ship on which the fat is made into oil and the other parts of the whale are processed. These ships are what the name implies, completely equipped factories filled from top to bottom with special machinery. Each factory ship is accompanied by a number of small, swift vessels known as whale-catchers.

Examples of sea life trawled from the bottom of the Weddell Sea.

Pack of Killer Whales in the Ross Sea.

A whale-catcher has a harpoon-gun to shoot the whale, and strong winches to pull him in. When a catcher has caught several whales, she tows them to the factory ship for processing.

Whales live entirely in the water but are not fish. They are warm-blooded animals and have other characteristics of land animals, such as elephants, horses, and even mice. A smaller cousin of the whale is the porpoise. In the Antarctic, one type of porpoise is so large that men have mistakenly named it the killer whale. These killer whales are about 30 feet long and are among the most savage of all beasts. They hunt in packs and will attack the great blue whale. They are tremendously powerful and have been known to break ice three feet thick to dump a seal into the water. A photographer on the second Scott Expedition had the ice broken where he was standing, but there are no authenticated instances of killer whales attacking men in the water.

Equally common are the seals. Like whales and porpoises, most seals live from the smaller fish and organisms of the sea. They have not, however, entirely lost their ability to climb out of the water and move about on land. In Antarctic history, seals have had an important part. The first men to see and set foot upon the continent came there looking for fur seals. They found them on the islands around Antarctica by the thousands, but, so greedy were these men, that the fur seals almost completely disappeared within less than 10 years. To prevent the same thing happening to the whales, the nations engaged in whaling have agreed to limit the number caught each year.

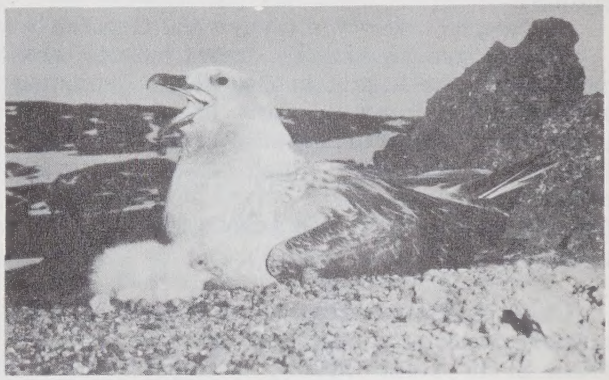
Five types of seals are found in Antarctic waters—crabeater, Weddell, Ross, and leopard seals come ashore on the margins of the continent, while a fifth, the elephant seal, is primarily seen on the off-shore islands.

The crabeater seal feeds on red krill, while the others live mostly on fish, except the leopard which also eats penguins. Seals are found in the pack ice, along the continental shore, and on off-shore islands, and, although carcasses have been found at considerable distances inland, they seldom venture far from their oceanic dining room.

Alone among the prevalent types, the elephant seal has economic value. It is occasionally hunted even today for its oil. The fur seal, which first drew men to the Antarctic, was long believed to be extinct. Recently a few small herds have been seen, and their numbers are increasing. Measures have been taken to protect these valuable beasts in the future.

Weddell seal and pup at McMurdo Sound.

Recently, many nations have also issued regulations to preserve the millions of birds that swarm along the shorelines of the continent or nest on nearby islands. They, too, eat principally fish and other sealife. There are many varieties of these birds, most of them not unlike the gulls and petrels that live along our coasts. Some of them actually migrate from the Arctic to the Antarctic every year. The most southerly of all birds is the south polar skua which has been seen on the icecap within a few miles of the South Pole itself. The skua is a savage bird, sometimes called the eagle of the Antarctic, that feeds not only on fish, but also on penguin eggs and chicks.



Above: Skua and chick at Cape Evans.

Below: Skua in flight.

Penguins are one of the world's most unusual birds and one of the most primitive still in existence. The penguin long ago gave up the ability to fly. His wings have turned into flippers, which he uses to swim through the water at great speed. On shore, the penguin usually stands upright and waddles about, looking like a comic book version of a man. When in a hurry, penguins will sometimes flop on their stomachs and use their webbed feet and flippers to help them slide across the ice.

Emperor

There are 17 species of penguins found in the world. All of these are in the Southern Hemisphere. Six species are found south of the Antarctic Convergence. Of these, the most prominent and only polar breeding species are the Emperor and Adelie. Emperor penguins are large, dignified birds. They are between 3 and 4 feet tall and weigh, when full grown, about 60 pounds. A blow from their flippers may be strong enough to break a man's arm. The most unusual thing about the Emperor penguin is that the chicks are hatched and raised in the middle of the dark, Antarctic winter. The adults do this by holding first the eggs and then the chicks on their webbed feet, and protecting them with a roll of fat, which falls down over them. When the winds blow and blizzards come, the Emperor penguins huddle together in groups to keep warm and safe.

The Adelie penguins are the clowns of the Antarctic. They are about a fourth the size of their cousins, the Emperors, and are much livelier. A rookery of these little birds is full of sound and motion. They are playful and curious and have no fear of men. As a result, they frequently get in the way of men trying to build bases, operate tractors, or do other things around an Antarctic station. By their antics, however, they amuse and cheer up men who are a long way from home.

The Adelies lay their eggs and raise their young during the Antarctic summer. They build nests of pebbles on bare places where the snow has melted. As winter comes on, they leave the land and follow the growing Antarctic ice pack out to sea so as to be near the open water where they find their food. To explorers, one of the signs of returning spring is the appearance near their camps of Adelie penguins after the long winter night.

Other types of birds frequently found there are fulmars, petrels, terns, and shags. In all, more than 30 species have been identified. All of them are closely tied to the sea, not only as a source of food but also as a migratory route from the continent and its cold winter night.

Adelie

Why Do Men Go to Antarctica ?

You may wonder why men go to the Antarctic. Why do they brave a difficult voyage across tempestuous seas or a dangerous flight over a trackless ocean? Why do they face the cold and the blizzards and the long months of darkness when the sun never rises?

To know the exact answer, it would be necessary to ask each person who has been there. Probably each would have his own answer. In the early days, some men went to look for fur seals. More recently, others have been in search of whales. But even these men, who sought a way to make a living, were lured on by the mysterious, white, silent, world of Antarctica. It seemed important to see and learn. Man has always wanted to know about the world in which he lives and this desire has driven him to cross deserts, climb mountains, and venture forth upon the sea.

Beyond man's wish to see is his need to understand. He must find what exists below as well as on the surface. Above the earth, mighty forces are at work that he must explain. This need to understand is the basis of science.

Scientific study has been a principal reason why men have gone to Antarctica. Since the first visits by scientists to the area in the middle nineteenth century, many expeditions have ventured toward the South Pole, and scientists have studied increasingly wide areas of the continent. There still remains much to be done.

Geographically, although much has been accomplished in recent years, Antarctica is the least known of continents. Explorers can still discover mountains never before seen and sail across uncharted waters to coasts where no man has trod. Our knowledge of the world will be incomplete until all Antarctica has been seen and mapped.

Enough is already known to mark the unique character of Antarctica. Now that the buffalo herds of our western plains are only a memory and the once great flocks of African animals are increasingly limited to a few game preserves, Antarctica alone retains the original distribution of its animals and plants virtually undisturbed by the presence of man. An Adelie penguin rookery, with as many as a quarter million chattering birds, is an awesome sight.

If the environment of Antarctica is rugged, it is also rather simple compared to other parts of the world. It gives biologists an opportunity to study how plants and animals adapt to living in extreme conditions. Antarctica serves as a sort of model which will help men to understand the process of evolution everywhere. Many questions remain about the distribution and migration of plants, insects, mammals, and birds that a better knowledge of the Antarctic can help to illustrate.

The seas about Antarctica support an extremely rich life; some scientists believe that they contain more nutrients per acre than any area in the world. As the number of men continues to increase, new sources of foodstuffs will be urgently required. Man has only just begun to farm and harvest the sea. To do so intelligently, he will need more information about the life of the sea than he now has. Marine biology is therefore an important study, particularly in an area so rich in foodstuffs.

Closely related to biology is medical research, for man himself is an animal, even if a rather unusual one. The severe environmental conditions, including cold, isolation, and high altitudes, present formidable problems of adaptation and an opportunity to study the reactions of men under unusual stress. Antarctica has been called the "steppingstone to space."

As important as the study of animals and plants is the investigation of the structure and resources of the land itself. Each summer season, geologists of many nations range far out into the field to investigate the geological formations of Antarctica. From such studies, much will be learned, not only about the land itself, but also about the origins and development of oceans and continents generally. The shape of large portions of the earth has been affected in the past by glaciers, but subsequent geologic events have obscured the evidence. In the Antarctic, the process is still going on and may be observed directly. It is also possible to study primitive soil action. All of these and many other things attract the geologists.

Antarctica alone among continents supports an icecap. In fact, if the ice were to melt, the land beneath would rise some 2,800 feet. The effect of this great weight on the earth's crust and its underlying mantle are matters of interest. Many men go to the Antarctic to study the ice itself. They are called glaciologists. They seek to determine the true size of the icecap and the mechanism of ice flow, for ice is plastic and it moves. So does the rock of the earth's crust, but very slowly. It is believed that a better knowledge of how ice moves, and is deformed as it does so, will help to understand the manner in which the crust of the earth itself moves and changes. Finally, glaciologists want to know whether the ice is increasing or decreasing. We know that the amount of ice has fluctuated in both hemispheres, that there have been ice ages and intervening warmer periods. At the present time, it is not known whether the ice in Antarctica is increasing or decreasing or whether fluctuations occur at the same time in both hemispheres.

Any change in the amount of ice is of course related to the climate. The whole complex relationship between the oceans, atmosphere, and ice is imperfectly understood. Meteorology, or study of weather, is therefore very important and has been the largest single program in the Antarctic. Most of us think of weather in the terms of forecasting, when we listen to a radio to find out if it will be a good day for a picnic tomorrow. Behind the forecaster, however, must be a great body of knowledge on how weather is produced. Particularly for countries of the southern hemisphere, but also for the world as a whole, the Antarctic has an important influence on weather both from day to day and over long periods.

Just as the icecap has its part in weather formation, so do the oceans that surround Antarctica. The study of the sea in all its aspects is called oceanography. We have seen that, to the biologists, the study of marine life is important. Its abundance and distribution depends, in part, upon the action of ocean currents and upon the mineral content and temperature of the water. The ice from Antarctica affects the water around it and has its part in stimulating currents which reach into the northern hemisphere. For thousands of years, the glaciers scraped the land of Antarctica and carried rocks and soil out to sea as part of icebergs. When the bergs melted, this debris dropped to the ocean floor. When dredged up, it provides geologists with information about the land hidden beneath the ice.

Air, as we think of it, is an extremely thin covering around the earth. Our atmosphere stretched outward a hundred miles or so, but only the first 15,000 feet contains enough oxygen to support human life. The upper atmosphere is constantly being bombarded by electrically charged particles from the sun and outer space. Since the earth is a magnet with its ends in the polar regions, many of these particles stream off toward the North and South Poles. Because the Antarctic is a land area and therefore stable, unlike the Arctic, which is a sea area covered with constantly shifting ice, it is expecially suited to the study of these particles and their effects upon the atmosphere. Most of the investigation of the upper atmosphere is done with electronic probers of various sorts. For this type of research, the Antarctic has the advantage of a low radio noise level largely due to the lack of thunderstorms.

Most of these particles never reach the earth but are trapped in the upper atmosphere. There they form a sort of blanket which, because radio waves bounce back off it, makes long range communications possible. This blanket is not always the same, and it may be disturbed by storms of new particles arriving from space. Sometimes these storms take on a visible aspect known as the aurora. In the United States we know the aurora as northern lights. A similar phenomenon in the southern hemisphere is called southern lights. These disturbances affect radio reception so that the study of the upper atmosphere is important for long-distance communications. Also, through this belt of radiated material, astronauts on their way to explore space will have to pass, and its nature may have a decisive influence on their success or failure.

These are only a few of the reasons why men go to the Antarctic. With all of them, there is a sense of adventure, the thrill of measuring themselves against the most rigorous climate on earth, but most of all there is the satisfaction of adding just a little to the store of human knowledge. The great Norwegian explorer, Fridtjof Nansen, once said,

> "Man wants to know, and when he does not want to know, he ceases to be a man."

Men in the Antarctic

Antarctica was discovered about 1820, but no one passed a winter on the continent until 1899. Between these two dates, many men saw the coast from ships at sea, and a few stepped ashore, but none stayed any length of time.

Who discovered the continent? There is no certain answer to this question. The ancient Greeks believed that a great southern continent existed, but, of course, none of them ever saw it. The natives of New Zealand, the Maoris, have legends about a white land somewhere to the south of them, but they are vague.

Serious history of the Antarctic really begins with Captain James Cook of the British Navy. Between 1772 and 1775, Captain Cook, with two ships, sailed completely around the continent without ever seeing it. He met plenty of pack ice, and from the birds he saw he came to believe there was land somewhere further south.

In the course of his voyage, Captain Cook discovered the island of South Georgia. Lying in the South Atlantic Ocean, South Georgia is one of the gateways to the Antarctic. On its beaches he spied fur seals, and this fact he recorded in the account of his travels.

This news was of great interest to hundreds of adventurous American and British seal hunters. The demand for seal skins was very great in those days. As the number of seals on known beaches decreased, the hunters sailed ever farther southward looking for new beaches. Cook's report was like a magnet, drawing them onward.

It seems probable that these sealers were the first people to see Antarctica. The sealers, however, frequently tried to keep their discoveries secret. They wanted to prevent others from knowing where the seals were. Also, they did not keep very good records, and many of those they did keep have been lost.

We are fairly certain, however, that on November 17, 1820, Captain Nathaniel B. Palmer, of Stonington, Connecticut, sighted the continent near the tip of the Antarctic Peninsula. On February 7, 1821, Captain John Davis, of New Haven, Connecticut, sent a boatload of men to look for seals on the shore of what is now called Hughes Bay. Captain Davis' logbook was found only a few years ago. It may be that in old houses or in the hands of descendants are other old logbooks. One of these may contain an earlier date for the first ship to see the Antarctic Continent.

On January 30, 1820, several months before Captain Palmer, a British ship had sailed through the same area, but the weather was bad. When the air cleared somewhat, those on board saw land to the south. This may have been the mainland, or it may have been an island off the coast. No one is quite sure.

During the same month, two Russian ships were cruising off the opposite side of Antarctica. Their commander was a fine Baltic sailor, named Bellingshausen, who was an officer in the Russian Navy. Bellingshausen was a cautious man. At times during 1820, he saw what might have been land, but it also might have been giant icebergs stuck fast in the pack. Unless he was sure, he would not say. Finally, on January 28, 1821, he saw a rugged, mountainous coast which he named Alexander I Land after the Emperor of Russia. Later explorers have shown that Alexander I Land is really an island separated from the continent by a narrow, ice-filled strait.

On February 7, 1821, the day Captain Davis had sent a boat ashore in Hughes Bay, he wrote in his logbook, "I think this Southern Land to be a Continent." He was right, but it was 19 years later before enough points along the coast had been seen to be sure. In the years between, United States and British ships made occasional sightings along isolated parts of the continent.

The real proof came from an expedition led by Lieutenant Charles Wilkes of the United States Navy. This was the first time our government sent its own ships to explore the Antarctic. Sailing from the United States, late in 1838, Wilkes first reached the Antarctic south of Cape Horn early the following year. After skirting the ice pack to the westward, he went to Australia during the Antarctic winter. He returned to the Antarctic south of Australia in December 1839 and saw land at numerous points over a distance of 1, 500 miles. After Wilkes returned, people knew there was a southern continent, and they called it Antarctica. Today, a big section of

Antarctica appears on our maps as Wilkes Land.

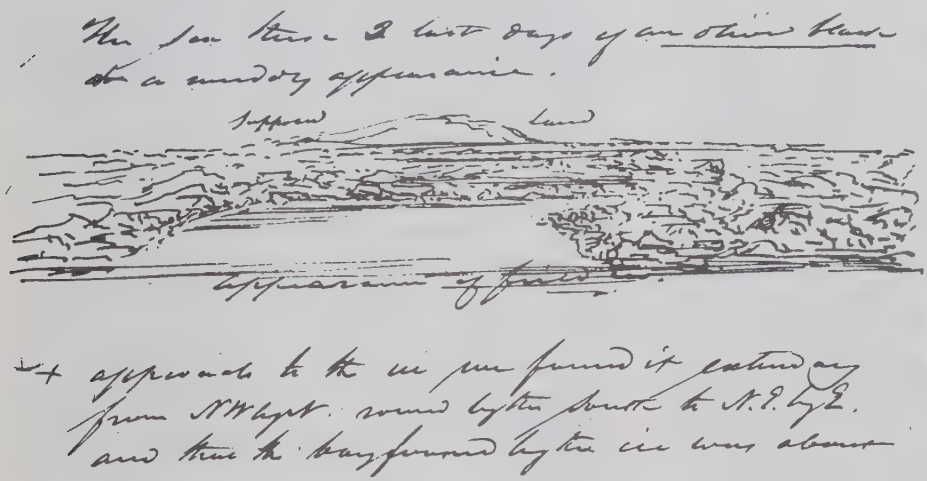
Imagine the surprise of the men on one of Wilkes' ships in January 1840. As they felt their way through a sea filled with icebergs, two ships flying the flag of France suddenly loomed up and then disappeared again. It was almost like seeing ghosts in this isolated, out-of-the-way place. Actually, they were the two ships of an exploring expedition that had left France in 1837. Their commander was Captain Dumont d'Urville of the French Navy. He, too, discovered parts of Antarctica, and one of them is now called the Adélie Coast, after the name of his wife.

Before he left the southern seas, Lieutenant Wilkes took time to write a letter telling about his discoveries to a British naval officer, James Clark Ross. Because he knew about Wilkes and d'Urville, Ross sailed farther east, going south of New Zealand. He also had ships that had been especially strengthened to resist the ice. For that reason, he plunged boldly into the ice pack, which in the summer season drifts north. After 4 days, his 2 ships came out of the pack into an open sea, a sea that now bears his name. There was no ice to be seen, and they could sail on south unhindered. As they went along, they began to see mountains to the west. Gradually, there appeared before their eyes one of the grandest views ever seen by man, the mountain ranges of Victoria Land. Ross was finally stopped by the great white cliffs of the ice shelf, but not before he had sighted Mount Erebus, an active volcano almost 13,000 feet high.

Before he returned to England, Ross made other discoveries, but none as important as the Ross Sea. In that area, he had sailed as far south as it is possible to go by ship. He had found the best way to reach the heart of the continent and the closest approach to the South Pole itself.

After Wilkes, d'Urville, and Ross returned to their homelands, men lost interest in the Antarctic. For 50 years, only occasional efforts were made to learn more about the mysterious, white continent.

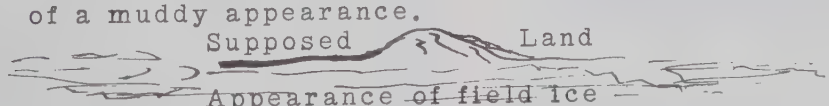
Shortly after 1890, attention was again fixed on the Antarctic and has continued ever since. There seem to be two principal reasons for this revival. First, scientists were convinced that they must know more about the south polar region if they were to understand the world and the uni-



Portion from the journal of Charles Wilkes, January 15, 1840, the sighting of land. Content of writing shown below.

Charles Wilkes

The sea these 3 last days of an olive black
of a muddy appearance.



approach to the ice we found it extending
from N.W. by N. round by the South to N.E. by E.
and there the bay formed by the ice was about

verse better. Second, new methods of whaling made it possible to catch and use Antarctic whales.

During the winter of 1898, a Belgian expedition under Lieutenant Adrien de Gerlache found its ship frozen fast. All winter long, the vessel drifted with the ice until another summer freed her. Just about the time the ice loosened its grip on the Belgians' ship, a British expedition, led by C. E. Borchgrevink, landed at Cape Adare. This landmark is at the western entrance of the Ross Sea. Here, Borchgrevink and his party built a hut. Their ship sailed away to New Zealand and returned to pick them up the following Antarctic summer.

These two expeditions began what has been called the heroic age of Antarctic exploration. Before de Gerlache, no scientific party had spent the winter in the Antarctic. Before Borchgrevink, none had attempted to live on shore. Before this time, men had been limited to what they could see during the summer. They had gone ashore only very briefly, if at all. Now they could set up a base one summer and begin journeys into the interior early the following spring. This has remained a principal method of Antarctic exploration to this day.

During the heroic period, men penetrated the continent and reached the South Pole itself. They faced dangers about which they knew little. Their equipment was frequently inadequate for the tasks they set themselves. They learned how to survive as they went. Above all they had courage, and from their efforts, their failures as well as their successes, the techniques of Antarctic exploration were learned.

In 1901, German, Swedish, and British expeditions took to the field. All had their exciting times. The Germans' ship was frozen in the ice within sight of their goal and drifted with the pack for a year. The Swedes, on the other hand, made shore, but their relief ship was crushed, leaving both the wintering-over party and the ship's company to make out as best they could. These men proved it was possible to live from what they could find in the Antarctic. A diet of seal and penguin, however, became somewhat monotonous. They remained in the area until November 1903, when an Argentine naval vessel came to their rescue.

The British National Antarctic Expedition (1901-1904) was commanded by Commander (later Captain) Robert Scott of the British Navy. Captain Scott had strong scientific interests that made his expedition one of the most important ever to enter the Antarctic. From his base at Hut Point on McMurdo Sound at the western end of the Ross Sea, many sledging parties set out to explore and observe. One went south over the Ross Ice Shelf for 380 miles. Two others climbed the Victoria Land mountains to reach the polar plateau for the first time. By the time Captain Scott left the area in 1904, his scientists, together with those from Germany and Sweden, had collected enough information to put Antarctic studies on a sound basis.

Scott Hut at Cape Evans on Ross Island, Antarctica.

From 1901, expeditions were in the area nearly every year. Between 1902 and 1904, a Scottish expedition explored the east side of the Antarctic Peninsula and set up a weather station on subantarctic Laurie Island. This station was turned over to the Argentine Government in 1904, and has been maintained ever since. Dr. Jean B. Charcot, a Frenchman, led ship-based parties to the west side of the Antarctic Peninsula on two occasions, 1903-1905 and 1908-1910. In 1911 and 1912, Japanese and German expeditions were in the area. The Japanese landed at the eastern end of the Ross Sea, while the Germans entered the Weddell Sea. They discovered the great Filchner Ice Shelf, which is named for their leader.

Increasing numbers of whalers were also active in the area. Many of them investigated places not previously seen. Some made maps of harbors and other geographic features. In 1905-1906, the Norwegians sent the first factory ship to the Antarctic. This method of whale-catching and processing freed the whalers from the need for land stations and revolutionized the industry. Almost all modern whaling is carried on by factory ships.

Among the men on Scott's first expedition was a young British naval officer, Lieutenant Ernest H. Shackleton. The Antarctic entered his heart, never to be absent until his death. As a leader, Shackleton showed great daring and imagination, combined with a practical sense of just how far to go. He took his first expedition to the Antarctic in 1907. A sledging party, which he led personally, crossed the Ross Ice Shelf, climbed the great glaciers at its head, and reached a point only 97 miles from the South Pole itself. Other parties climbed Mount Erebus and scaled the Victoria Land plateau, where one of them located the South Magnetic Pole.

Shackleton's hut at Cape Royds on McMurdo Sound, built on the 1907-1910 expedition.

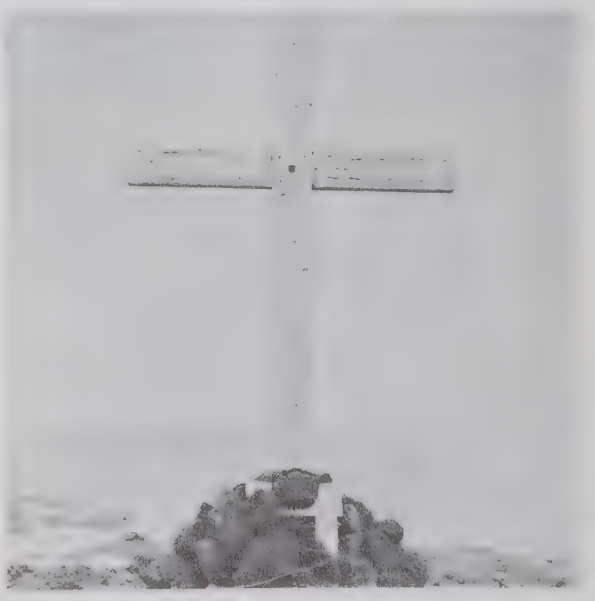
The climax to the heroic period came in 1911 and 1912, when the South Pole was reached. First to arrive was the great Norwegian explorer, Roald Amundsen. Leaving from the Bay of Whales in October 1911, Amundsen and four companions reached the vicinity of the Pole on December 14, and spent the next three days checking and rechecking their position. Amundsen's journey showed his great skill as an organizer and proved that teams of Eskimo dogs were the best means of transport.

About a month after Amundsen, Captain Scott and four other Englishmen stood on the same spot. They had started from McMurdo Sound, a considerable distance farther from the Pole than the Bay of Whales. For transport, they had Siberian ponies, but these hardy little beasts proved unequal to the task. For the greater part of the way, the men depended on their own strength, hauling their sled themselves.

On the return from the Pole, bad luck followed in their footsteps. Growing weaker each day from their great exertion and lack of proper food, they also encountered storms and blizzards. One man died on the trail. Another, feeling that he was sick and too great a burden to the others, walked from their tent into a raging storm to die alone. Captain Scott and his two remaining companions struggled a little further until they, too, were trapped by a blizzard. They died in their tent, a scant 10 miles from their next food depot. They faced death, as they had life, like gallant gentlemen.

The following spring, a relief party found the tent and collected Captain Scott's papers and diaries. Among other items, it found 30 pounds of rocks, all selected for their scientific interest. Despite cold, hunger, and weakness, they carried these valuable specimens to the end. Even with the personal tragedy, Scott's second expedition became like the first—a triumph for science.

By his emphasis on scientific studies, Scott had done as much as any man to make certain that exploration of the Antarctic would continue. Even after the discovery of the South Pole, men had much to learn. Very little of the continent had been seen, and the forces affecting the weather little understood. In fact, knowledge of the Antarctic and its importance was just beginning.



It is believed this cross marks the grave of three members of Scott's ill-fated expedition. A tube discovered here in February of 1947 contained a list of those believed buried here.

While Scott and his men were struggling to their unfortunate end, an Australian expedition under Douglas Mawson had set up two bases south of Mawson's homeland. A distinguished scientist, Mawson is considered to be one of the great Antarctic explorers. On this expedition, 1911-1914, Mawson set up camp along George V Coast at what is perhaps the windiest spot in the world. On one occasion, he reported winds of over 200 miles per hour; 100 mile per hour reports were frequent.

In the meantime, Shackleton was at work organizing another expedition. He had the great dream of crossing Antarctica from the Weddell Sea to the Ross Sea by way of the South Pole. The main party, led by Shackleton, would go to the Weddell Sea and make the actual journey. A supporting party would operate out of McMurdo Sound and would lay depots of food and fuel across the 400 miles of the Ross Ice Shelf.

What followed is one of the greatest adventures in the history of exploration. Shackleton's ship, ENDURANCE, froze fast in the pack and drifted over 500 miles before she was overcome by the power of the ice and crushed. The crew took to the pack, saving such supplies and equipment as they could, including their small boats. These men lived on the ice from October 1915 to April 1916, continuing to drift northward. Finally, the pack broke up under them, and they took to their boats, heading for Elephant Island in the South Shetlands, which they reached without loss of a man.

Shackleton, after a short period of rest, set forth again with five companions to sail to South Georgia, where he could get help from the whaling stations. This voyage across 800 miles of the roughest seas in the world is an heroic feat almost without equal among adventures in small boats. As they approached South Georgia, a violent storm blew up and they landed on the opposite side of the island from the whaling stations. Shackleton and two others decided to cross the island to get help. This meant scaling ice-covered mountains that no one had ever climbed. In the end, they made it, but there were still men on the other side of South Georgia and those on Elephant Island to rescue.

Whale-catchers picked up the men on South Georgia, but Elephant Island was a more difficult problem. Three times ships were turned back by the ice. Finally, the Chilean vessel YELCHO, with Shackleton aboard, reached the island and took the men off. In all these perilous adventures not a man was lost.

The Ross Sea party was not so fortunate. Its ship was caught in the ice and then drifted away with the pack, carrying a large part of the equipment and supplies with her. Under great difficulties, the men laid their depots. One man, however, died on the trail, and two others disappeared when the sea ice broke up. On January 10, 1917, the ship finally came back to rescue the survivors.

Shackleton returned once more to the region he loved so well. Early in January 1922, his ship reached South Georgia, and there he died of a heart attack. He lies buried in that gateway to the Antarctic. Carefully tended by the rough men of the whaling station, his grave is a shrine to all who pass that way.

Shackleton's death closed the heroic era of Antarctic exploration. It remains dangerous to penetrate the continent, but expeditions and trail parties have radios to keep in touch with their fellows. The growing use of airplanes and tractors makes speedier rescues possible.

The first airplane flight in the Antarctic was made on November 26, 1928. Aboard the plane was the expedition leader, Sir Hubert Wilkins, an Australian, and the pilot, Carl B. Eielson, an American with experience in Alaska. The man, however, who made the most extensive use of aviation in Antarctica was Rear Admiral Richard E. Byrd. In fact, it may be said of Admiral Byrd that, more than any other explorer, he brought modern machines and methods of communication to the area.

Before leading his first expedition to the Antarctic, Byrd had already had a distinguished career in aviation. He had been the first man to fly over the North Pole and had flown the Atlantic. He also had been prominent in developing the instruments which made such flights possible. Byrd's great skill as a navigator was one of his outstanding accomplishments. In action, he combined Scott's interest in science and Shackleton's caution for his men with a high degree of technical skill and outstanding ability as an organizer.

The first Byrd Antarctic Expedition (1928-1930) is best remembered by most people for its flight over the South Pole, on November 29, 1929. Probably even more important were the discoveries of the Edsel Ford Range, the Rockefeller

Above: "Bear of Oakland" at the Bay of Whales in 1934. Below: Rear Admiral Richard E. Byrd

Mountains, and Marie Byrd Land, and the work of the expedition's scientists under Dr. Laurence Gould. Basing at Little America on the Bay of Whales, the same location as Amundsen had used, Byrd showed conclusively how effectively the airplane, even with limited range, could be used as a tool of the explorer.

The second Byrd Expedition (1933-1935) concentrated on scientific work and used tractors more extensively than any previous expedition. It was on this occasion that an advance weather base was set up about 100 miles south of Little America II. Here, Admiral Byrd stayed alone from March 28 through August 10, 1934, keeping a careful record of the weather. No man had ever wintered so far south before. Because of a faulty stove and exhaust fumes from a motor, Byrd very nearly died before a rescue party reached him.

The type of scientific work carried on by Byrd was also performed by a British-Australian-New Zealand Expedition (1929-1931) under Sir Douglas Mawson and the British Graham Land Expedition (1934-1937) under John Rymill. Another kind of scientific work received great impetus from the British Discovery Committee. Almost every year this official group sent a ship to the Antarctic to study the sea and the plants and animals that lived in it. If they discovered all about how the whales lived and what their habits were, it would be possible to save these valuable animals from the kind of destruction that had happened to the fur seals a century before. The ships of the Discovery Committee also sighted land in many places, did mapping, and helped explorers.

Other discoveries were made by the whalers themselves. Particularly active in this respect was the Norwegian whaling company directed by Lars Christensen. His factory ships carried airplanes, which they used both to look for whales and to fly over the coast of Antarctica. On some of these voyages, the captains of the ships took their wives along. On February 20, 1935, Mrs. Klarius Mikkelsen accompanied her husband ashore in a small boat. As far as we know, she was the first woman to set foot on Antarctica. In 1937, Mrs. Christensen accompanied her husband on a whaling expedition and became the first woman to fly over part of the Antarctic continent.

Admiral Byrd was not the only American to interest our country and stir the imagination of its youth. Another was Lincoln Ellsworth. A sportsman who loved the outdoors, Ellsworth lived a life of adventure. Like Byrd, he, too, had experience in the Arctic and had flown over the North Pole before he first came to Antarctica in 1933. Ellsworth's great ambition was to fly across the continent. This feat he accomplished in 1935, after two earlier attempts had not succeeded. Ellsworth took off from Dundee Island on November 23 and came down several times en route to determine his position or wait out storms. Finally, on December 5, he arrived 16 miles short of his goal, Little America. He and his pilot hiked the rest of the way. Ellsworth made a final journey to the Antarctic in 1938-1939 during which he surveyed from the air the area now called American Highland.

During the same season, a small German expedition was busy mapping part of the Antarctic coast. It showed what could be done by seaplanes based on a tender that remained just beyond the edge of the pack. In a very short time, they covered a large area, using aerial cameras.

The use by Byrd and others of aircraft, tractors, radio, and complex scientific instruments, however, gradually made privately financed expeditions like Lincoln Ellsworth's almost impossible. Equipment costs a lot of money and requires a lot of men to keep it operating. Only governments really have the money for large scientific expeditions.

"Bear of Oakland" at West Base in January 1941.

The turning point came in 1939 when our government set up the United States Antarctic Service, under the command of Admiral Byrd. Two bases were established: one, called West Base, at Little America III on the Bay of Whales, under the leadership of Paul Siple, who had first gone to the Antarctic as a Boy Scout with Byrd in 1928; the other, called East Base, on Stonington Island in Marguerite Bay off the west coast of the Antarctic Peninsula, under the leadership of Richard Black, a veteran of the second Byrd Expedition. As on previous United States expeditions, ground parties made long journeys gathering information. Aircraft also took aerial photographs and explored areas beyond the reach of men on the surface. The plans of the United States Antarctic Service called for permanent bases. Each year a new group of men would replace those who had stayed over the winter. In 1939, however, war broke out in Europe. As the war came closer to the United States, it was decided to close down the bases in the Antarctic. The men left West Base on February 1, 1941, and those at East Base were flown out a few weeks later on March 22.

View of sledging party taken on the U. S. Antarctic Service Expedition, 1939-1941. Wheel on back of sledge was used to indicate distance travelled.

World War II did not quite reach Antarctica, but it came close. German commerce raiders used subantarctic islands as places of refuge, and these same German ships captured the Norwegian whaling fleet. These actions so alarmed the British that, in 1943, they sent a military force to the Antarctic Peninsula. The leader of this force was Lieutenant Commander J. W. S. Marr, who had begun his Antarctic experience as a Boy Scout on Shackleton's last expedition. Marr set up two bases, one off the west coast of the Antarctic Peninsula, and the other in the nearby South Shetland Islands.

When the war was over, the British decided to keep these bases and to open others. Since that time, they have occupied more than a dozen sites, some of them only briefly, along the Antarctic Peninsula, on nearby islands, and on the shore of the Weddell Sea. Each year, new groups of men arrive at the bases to relieve those who have been there during the previous winter and to carry on scientific projects. The British named this program the Falkland Islands Dependencies Survey (now the British Antarctic Survey).

Argentina and Chile have adopted similar programs in the same general area. Not only have the Argentines continued to operate their weather station on Laurie Island, but also have established bases at many other points. The Chileans have occupied four bases, which they maintain regularly, and have set up a number of huts capable of summer occupancy.

The United States had been the first country to plan permanent stations. It did not, however, continue this program after World War II. Instead, it went back to expeditions that remained in Antarctica for a limited time. The first of these was in 1946 and 1947 and was given the name Operation HIGHJUMP. Rear Admiral Byrd was the Officer in Charge and Rear Admiral R. H. Cruzen commanded the Navy Task Force. With 13 ships and over 4,000 men, Operation HIGHJUMP is still as large as any expedition ever sent to the Antarctic.

One outstanding event of the operation was the flight of six 2-engine transport planes from a Navy aircraft carrier to the Bay of Whales. Another was the success of icebreakers in carving a path through the pack ice. Still a third was the use of aircraft tenders and seaplanes to photograph large areas never before seen. When the flights of the transport aircraft from the camp, called Little America IV, on the Bay of Whales were added to the work of the seaplanes, Operation HIGHJUMP discovered more of Antarctica than all previous expeditions combined.

Flotilla of Task Force 68 transiting the Ross Sea on Operation HIGHJUMP (1946-1947). Led by an icebreaker, the ships are sailing toward Little America on the Bay of Whales.

Accurate maps cannot be made from aerial pictures unless they can be related to definite points on the ground. Sufficient ground control points had not been established by Operation HIGHJUMP. The Navy, therefore, sent a second expedition to the Antarctic in 1947-1948. It had two icebreakers under Commander Gerald L. Ketchum. People called this expedition Operation "Windmill" because it made extensive use of helicopters to put men ashore to take sights.

On the way out of the Antarctic, the icebreakers called at Marguerite Bay. There, they helped to free the ship of another United States expedition by opening a channel through the ice. Under the leadership of Commander Finn Ronne, a veteran of two expeditions with Admiral Byrd, the old United States base at Stonington Island had been reoccupied. This group continued and greatly extended the work begun by the United States Antarctic Service in 1940 and 1941. Among the members of the wintering-over party were Commander Ronne's wife and the wife of one of the aircraft pilots, Mrs. Darlington, the first women ever to experience the hardships of an Antarctic winter. Even though he received extensive government assistance, Ronne's was the last privately organized United States Antarctic expedition.

Early in 1950, the French returned to the Adélie Coast for the first time since its discovery by Captain Dumont d'Urville more than a century before. They established ground control points that made possible the preparation of maps of the area around their base from aerial photographs taken during Operation HIGHJUMP. They carried on other scientific activities and, before their final withdrawal in 1953, studied Emperor penguins more thoroughly than anyone had ever done before.

At the same time a combined Norwegian-British-Swedish expedition (1949-1952) had come ashore near Cape Norvegia. Like other postwar groups, it brought much new scientific equipment. Particularly interesting were the studies of what was beneath the ice. This is done by setting off dynamite explosions. The shock waves from the explosion travel down through the ice until they strike solid rock. Then they bounce back much as sound waves bounce off a cliff to make an echo. The time that a shock wave takes to reach solid rock and return can be measured by an instrument called a seismograph. This expedition found this portion of Queen Maud Land to be like Norway, a land of high hills, steep slopes, and deep valleys.

Australians have always been interested in the seas and lands that lie south of their home country. Beginning in 1947, they established bases on two subantarctic islands, Heard and Macquarie. After several years of successful work, the station on Heard Island was closed, and the Australians in 1954 moved their men to the Antarctic mainland at a base they named Mawson, after their distinguished scientist and explorer.

Antarctic Stations – International Geophysical Year and Current

All-Out Assault

Admiral Byrd, who died in 1957, always liked to think of the Antarctic as a great white continent of peace, a place where men of all nations could work together pushing back the frontiers of human knowledge. He lived long enough to see his dream on its way to accomplishment. Twelve nations were engaged in an all-out assault to unlock the secrets of Antarctica's icy wastes.

This assault was a part of the International Geophysical Year, a program of cooperative scientific investigation in all parts of the world. Over 60 nations and 30,000 individual scientists participated. From July 1, 1957, to December 31, 1958, they manned more than 1,000 stations from pole to pole and around the earth from east to west. They carried out programs of simultaneous observations and sent their results to World Data Centers, where they are available to all scientists everywhere.

They studied the geophysical sciences, which are often called the earth sciences because they deal with our earth and the forces which affect it. In general, these are the studies which have long drawn men to the Antarctic.

The idea of an international cooperative effort was not new or without precedent. A century ago, a United States naval officer, Commander Matthew Fontaine Maury, who was also a famous scientist, suggested that the maritime nations of Europe and America join together in studying the Antarctic. Nothing came of this proposal because of the outbreak of the Civil War in this country. The idea did not die, however, and it was revived in a different form after 1874 by Lieutenant Karl Weyprecht of the Austrian Navy. At his urging, 11 nations established 14 stations in and about the polar regions during 1882-1883. None of these stations were in the Antarctic, and only two, one at South Georgia, the other at Cape Horn, were on its fringes. This first International Polar Year, as it was named, was succeeded by a second one 50 years later during 1932-1933, in which 44 nations participated. Again, the Antarctic was barely touched upon.

On the evening of April 5, 1950, a group of friends met together at a home in a suburb of Washington, D. C. Among those present were Dr. Sidney Chapman, a famous British geophysicist, and Dr. Lloyd Berkner, who had been a radio engineer on the first Byrd Antarctic Expedition. During the conversation, Dr. Berkner suggested that the time had come for a third polar year. Among other reasons, he pointed to the rapid advance of all the geophysical sciences and the fact that, during the two earlier polar years, the sunspot cycle had been near its minimum. A third such year, coming in 1957-1958, just 25 years after the previous one, would find the sunspot cycle near its maximum.

With the encouragement of those present, Drs. Berkner and Chapman interested international organizations of scientists in the idea. Many of those consulted felt that the value of the observations would be greater if they were not limited to the polar regions. Much could be learned by comparing and combining information from the poles with similar information from tropical and temperate zones. The matter was considered by the International Council of Scientific Unions, to which most of the national academies of sciences in the various countries belong. This body decided that a worldwide effort was needed and gave to it the title of International Geophysical Year. It also organized a special committee to develop a program and coordinate the effort of the world's scientists.

This committee established subcommittees for the different scientific studies and also several for regions that had special problems. Included among these subcommittees was one for the Antarctic because that region was believed to be "of almost unparalleled interest in the fields of geophysics and geography alike."

These committees developed programs that showed what the scientists thought ought to be done. They left it to the national academy in each country to decide how much and what portions of these programs it was able and willing to carry out. What happened in the United States is typical of what happened in over 60 nations. Our National Academy of Sciences set up a committee for the International Geophysical Year, and this committee, in turn, created subcommittees, including one for the Antarctic. The honorary chairman of our Antarctic committee was Ad-

miral Byrd, and the chairman was Dr. Laurence Gould, who had been chief scientist of the first Byrd Expedition in 1928-1930.

From the beginning, the United States Government said that it would support the programs with the necessary funds. Gradually the scientists and the government, represented by the National Science Foundation, determined just how much of the international scientific program the United States could afford. With this information, our scientists could go to international meetings and tell the scientists of other countries what we were prepared to do.

When the representatives of all the countries met together, they found that sometimes two of them had decided to do the same thing. At other times, no one had volunteered to undertake a desirable project. Working together in a friendly fashion, they made many changes. Duplications were eliminated and gaps filled in. Scientists from all over the world had a common objective to increase the body of scientific knowledge by making the International Geophysical Year a success.

The Antarctic was a special case. To transport a scientist with his equipment to the Antarctic and to house and feed him while he carries on his important work is expensive. It costs more, for example, than to set up a scientist in his own country or even more than to send him to a remote island in the Pacific or to an isolated village high in the Andes Mountains. The whole effort to deliver men and equipment to places where they do their work and to maintain them there is usually referred to by the general term "logistics." The logistics of Antarctic operations are difficult and expensive.

The Antarctic program of the International Geophysical Year included not only scientific stations on the continent and off-shore islands but also stations on subantarctic islands and on the mainlands of Australia, New Zealand, South Africa, and South America. The reason for this extensive coverage was to tie the Antarctic into the Southern Hemisphere and the worldwide patterns of observation. In the field of meteorology (i.e. the study of weather), it would be possible for the first time to make weather charts of the entire southern end of the world.

Twelve nations responded to the suggestion of the international committee for Antarctica. They were Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Norway, Republic of South Africa, Union of Soviet Socialist Republics, United Kingdom, and United States. Most of them had a background of Antarctic or Arctic experience on which to plan their expeditions. They agreed to the establishment of over 60 stations at which observations would be made. The most daring idea brought forward was the establishment of scientific parties on the great polar plateau. Except for Byrd's solitary advance base on his second expedition, no man had ever attempted to pass the dark, winter night away from the seacoast.

The United States offered to set up a station at the South Geographic Pole; France, one at the South Magnetic Pole; and the Soviet Union, one at the South Geomagnetic Pole. The United States and the Soviet Union also proposed to establish other plateau stations. As a supplementary project, not strictly a part of the International Geophysical Year, the nations of the British Commonwealth revived Shackleton's plan for a journey across Antarctica from the shores of the Weddell Sea to McMurdo Sound. They would use tractors as their basic means of traveling, but, like the earlier explorers, they also had dog teams.

The programs put forward by the various countries required advance preparations. Although the International Geophysical Year was not to begin until July 1, 1957, the United States Navy sent the icebreaker USS ATKA to the Antarctic in the autumn of 1954. ATKA went to look for sites for stations. She found that the Bay of Whales had disappeared when the ice shelf had broken off and floated away in the form of icebergs, carrying to sea part of Little America IV, set up during Operation HIGHJUMP.

The next year, 1955-56, most of the major expeditions got under way. Especially for those that planned stations on the plateau, this much time in advance was necessary. As long journeys and base construction cannot be done during the Antarctic winter night, men must take advantage of the months of daylight and comparative warmth. This means they must begin their work as soon as possible, about October 1. Ships, however, cannot usually cross the pack ice until December. Building materials, equipment, and supplies are taken in between December and March, stored

Naval Air Facility McMurdo Sound in 1956.

Little America V on the Bay of Whales in 1956.

over the Antarctic winter, and used the following spring. If they were to have the buildings set up, the scientific instruments in place, and everything ready by July 1, 1957, they had to start shipping things south in the autumn of 1955.

For its operations in the Antarctic, the United States Navy uses the code word DEEP FREEZE. On Operation DEEP FREEZE I (1955-1956), the Navy established two stations. One was at Kainan Bay, about 30 miles east of where Admiral Byrd had set up four previous Little Americas. It was called Little America V, and Admiral Byrd was at the commissioning ceremony. He was on his last trip to the Antarctic. The other station was built at Hut Point on Ross Island in McMurdo Sound, the spot where the British explorer, Captain Scott, had camped on his first expedition. It was named the Naval Air Facility, McMurdo Sound. The building materials for Byrd Station, to be erected at 80° South, 120° West, were stored at Little America V. On December 20, 1955, four United States naval aircraft flew to McMurdo Sound from New Zealand. For the first time, large cargo aircraft had taken off from a land mass and come down on the Antarctic Continent. While they were in Antarctica, they carried out a series of flights for purposes of exploration. They covered almost two million square miles, about half of which had never been seen before.

The expeditions of other nations were equally busy. A French expedition arrived off the Adélie Coast at Point Géologie on January 1, 1956. They built a scientific station that they named Dumont d'Urville in honor of their great explorer of a century before. The British set up two stations in the Weddell Sea, one a scientific station at Halley Bay and the other the base for the Trans-antarctic Expedition on the Filchner Ice Shelf. This second one they named Shackleton after the man who had first thought of crossing the continent. The Soviet Union also sent an expedition which established a station in Queen Mary Land, off the Indian Ocean. Although a Russian whaling fleet had been active since World War II, this was their first exploring expedition to the Antarctic since the days of Bellingshausen in 1820-1821. They named their station Mirnyy after one of his ships.

The Soviet station Mirnyy, built during the IGY.

The Russians, however, had great experience with cold weather operations in the Arctic, and they brought with them a great deal of fine equipment. Because the Arctic and Antarctic are different, they encountered some unexpected difficulties, and had to modify some of their equipment before carrying out their full program. During their first season, they succeeded in setting up a station 233 miles south of Mirnyy at an elevation of almost 9,000 feet. The four Russians who remained there were the first men ever to spend an Antarctic winter night on the polar plateau.

The expeditions of 1955-1956 were really preliminary. Other countries, such as Argentina, Britain, and Chile in the Antarctic Peninsula, and Australia in its part of the continent, continued their already established programs. The big effort would come the following year.

The season of 1956-1957, which the United States refers to as Operation DEEP FREEZE II, was the greatest in Antarctic history. Never before had so many men set forth for the area nor had so many of them gone with the intention of spending the winter. The United States sent 12 ships and over 3,000 men. In addition to the naval aircraft like those on DEEP FREEZE I, the Air Force sent eight large cargo planes called Globemasters. These Globemasters were to drop the building supplies and materials for the South Pole Station and to help the tractor train that was to carry the materials to Byrd Station by parachuting fuel along the way.

Before these operations began, the commander of the United States forces, Rear Admiral George J. Dufek, flew to the South Pole on October 30, 1956. He and his crew were the first men to stand at the bottom of the world since the parties of Amundsen and Scott in 1911 and 1912. When they stepped down from their plane they found the temperature 58° below zero Fahrenheit and the wind blowing hard. Admiral Dufek decided to wait three weeks for the weather to warm up before sending in men to build the station.

Picture taken at the South Pole on the first aircraft landing at that point. Plane is a C-47.

While they were waiting, a group of Army and Navy men set out from Little America V to lay out a trail to the site of Byrd Station. The Army men, who had served in Greenland, were specialists in traveling over snow and ice. As Admiral Dufek said, the Navy had plenty of men who knew how to drive tractors, but they lacked experience in the polar regions. For that reason, he asked the Army for experts. The Army was glad to help, just as the Air Force was glad to send specialists in dropping supplies from the air. These men from the armed services worked together to set up our two stations on the polar plateau. When they had finished, they turned the stations over to Navy men and civilian scientists who would carry on the observations of the International Geophysical Year. The station at the South Pole they named the Amundsen-Scott IGY South Pole Station.

Tractor trains on the heavy swing to Byrd in 1957.

Below: Airdrop over Byrd Station during the IGY.

While these men were busily at work on the plateau, Navy ships and construction crews set up three other stations. One was at Cape Hallett on the Ross Sea. Here, United States and New Zealand scientists worked together. A second was established on the Knox Coast in that part of Antarctica which had first been seen by Wilkes in 1839 and 1840, and it was given his name. The third received the name of Ellsworth after another of our explorers. It was built across the continent on the shore of the Weddell Sea. The United States, like other nations in the Antarctic, frequently honored the pioneers of exploration by naming stations after them. When the last ships and aircraft left the area in February and March, 317 Americans remained behind at the 7 stations.

The French established a base near the South Magnetic Pole, and the British Commonwealth Trans-Antarctic Expedition set up a station called South Ice between Shackleton and the South Pole. The Russians added Vostok, named for the second of Bellingshausen's ships, and Oazis, in an ice-free area of the Knox Coast, to the already existing bases at Mirnyy and Pionerskaya. Norway and Japan also sent expeditions, each of which set up a scientific station. With their addition, 10 nations had establishments on the Antarctic Continent, while the Republic of South Africa occupied sites on three subantarctic islands.

The target date was July 1, 1957. As the ships and aircraft left the Antarctic in February and March, scientists set up and tested their instruments. A few days before the scheduled beginning of the International Geophysical Year, the sun began to show signs of interesting activity. The telltale spots on its surface that indicated gigantic explosions began to appear in numbers. All over the world scientists were alerted, and they were ready. The International Geophysical Year got started during one of the greatest of recorded magnetic storms.

This beginning was prophetic. The scientists went from one success to another. The results exceeded the hopes of those who planned the great scientific effort. In the Antarctic, as elsewhere, the men from different nations worked together in harmony. At Little America V, a weather central was set up. To this spot, stations throughout the Antarctic sent their weather reports. At the weather central were men from several nations to receive and interpret these reports and for the first time in history to draw up weather charts of the whole area. When a Japanese vessel encountered difficulty with the ice, the Soviet ship Ob' gave her assistance. Such help of one expedition by another has been an outstanding feature of recent Antarctic activity. Since 1957, for example, the United States Navy has sent ships to aid the Japanese, Belgians, Argentines, and British.

The Antarctic summer of 1957-1958, the United States Navy's Operation DEEP FREEZE III, was largely a period of relief and resupply. New groups of scientists, technicians, and support personnel arrived to take over from those who had already spent a year in the Antarctic. The Belgians became the twelfth nation to join the program. At 23° East, south of the Indian Ocean, they established a station, which they named after their sovereign, King Baudouin.

It was also a year of great journeys. The best known was the crossing of the continent by the British Commonwealth Trans-Antarctic Expedition. The plan resembled that of Shackleton's 1914 expedition. The main party under the leadership of Dr. (now Sir) Vivian Fuchs was to land on the shore of the Weddell Sea and journey overland to McMurdo Sound on the Ross Sea by way of the South Pole. A supporting party from McMurdo Sound was to lay depots of food and fuel on the Ross Ice Shelf and the polar plateau for the use of Fuchs and his companions on the final stage of their crossing. The supporting party was primarily a New Zealand concern under the leadership of Sir Edmund Hillary, who a few years before had led the first party to climb Mount Everest.

Vehicles on the British Transantactic Expedition.

Starting out in October, the New Zealanders, using ordinary farm tractors which they had changed somewhat for use on ice and snow, pushed across the Ross Ice Shelf and up the Skelton Glacier to the polar plateau. They put down depots of supplies and marked a trail for Fuchs to follow later. Originally, they intended to go about 700 miles from their base at McMurdo Sound and then return. Hillary, however, found that he had enough fuel to push on to the United States station at the South Pole. He and his companions arrived on January 4, 1958, the first men to reach this isolated spot overland since the days of Amundsen and Scott. United States aircraft flew them back to McMurdo Sound.

At about the same time, Fuchs had set out on November 24, 1957, from Shackleton Base on the Weddell Sea. His party used two kinds of vehicles with tracks. One type was called a Weasel and the other a Sno-Cat. Sno-Cats are big enough for men to cook and live in. A dog team pulling a sled went ahead of the vehicles to pick out the best route through untravelled country. Even with the help of the dogs, the journey was dangerous and difficult. Several times Sno-Cats

Modified farm tractor such as that used by Fuchs.

partly fell into crevasses, and the men had a hard time getting them out. On January 20, 1958, Fuchs and his men reached the South Pole. Admiral Dufek and Sir Edmund Hillary were there to meet them.

For a few days, the members of the expedition rested. Then, if they were to complete their journey, they had to push on. Because Hillary had already marked a route, they no longer needed the dogs. Admiral Dufek had the dogs flown by aircraft to McMurdo Sound. A few days out on the trail Fuchs left the Weasel behind. It had begun to break down. Besides, it was not as fast as the Sno-Cats, and Fuchs had to hurry if he was going to finish his journey before another Antarctic winter began. On March 2, 1958, he reached New Zealand's Scott Base. The Americans from the Naval Air Facility only two miles away joined the celebration. The sailors who could play musical instruments made up a band. It played loudly, if not very skillfully, to greet Fuchs and his men.

The British Commonwealth Trans-Antarctic Expedition had made the dream of Shackleton come true. It had crossed from the shores of the Weddell Sea to those of the Ross Sea. Along the way the men had made scientific observations. Ever since the United States had established Byrd Station and found that, although it was 5,000 feet above sea level, it stood on 10,000 feet of ice, many men doubted that Antarctica was a continent. They thought it might be a group of mountainous islands covered by a single icecap. Fuchs found that most of the way across there was land under the ice. This seemed to show that a continent really exists. Much more work will have to be done before the scientists will be sure what the land beneath really looks like.

While Fuchs and his men were making their journey, scientists of other countries also travelled about Antarctica carrying on their studies. Such trips are called traverses. On them scientists investigate the thickness and nature of the ice, changes in the pull of gravity, and the earth's magnetism. They also record the weather and try by observing the sun to tell exactly where they are. This "shooting the sun," as they call it, is important in making accurate maps. When mountains stick through the ice or the snow melts away in the summer, they stop to collect rocks, plants, and insects.

The equipment used by Fuchs and Hillary was typical of modern Antarctic exploration on the ground. Vehicles with tracks pull sleds across the great white wastes. Often the vehicles themselves are large enough for the men to eat and sleep in, but tents are also used. Dogs are still employed by some expeditions, particularly in mountainous areas such as the Antarctic Peninsula.

Otter aircraft flying over Sno-Cats on traverse during the IGY.

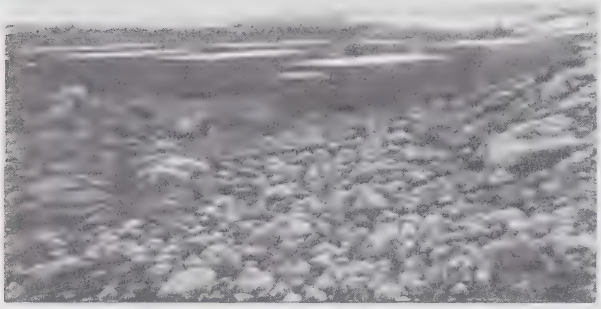
The New Zealanders have flown dog teams to places where it would be difficult or even impossible for tractors to go. Once in the field, these parties could also be supplied by aircraft with food and other needed items. When they have finished their work in one place, they can be picked up and taken to another. Small groups working in local areas still occasionally man-haul their sleds as did Scott and Shackleton.

At the other extreme from man-hauling are the airborne traverses. A ski-equipped airplane lands at regular intervals, and a small party measures ice thickness and takes other observations. In this way, great distances can be covered, but not so completely or thoroughly as by ground traverses.

The observations of the traverse parties, when added to the observations made at the stations, produced a large amount of information. As originally planned, United States stations and most others were to close after the end of the International Geophysical Year on December 31,

1958. The last traverses would have gone out in October and November 1958. When they returned from their trips, the men everywhere were to pack up their gear and leave the Antarctic largely to the seals and penguins, as it had been for centuries.

The scientists, however, found the International Geophysical Year too valuable to stop. They had learned a great deal, and also they had learned that they needed to know a great deal more about many things. Instead of ending their search for knowledge, in many fields they were just getting a good start. The expeditions of 1958-1959, which were to have ended the effort at most stations, saw new groups of scientists and maintenance men arrive to continue the good work. An era of permanent occupation of many parts of the continent was beginning.



Wilkes IGY Station under construction in 1957.

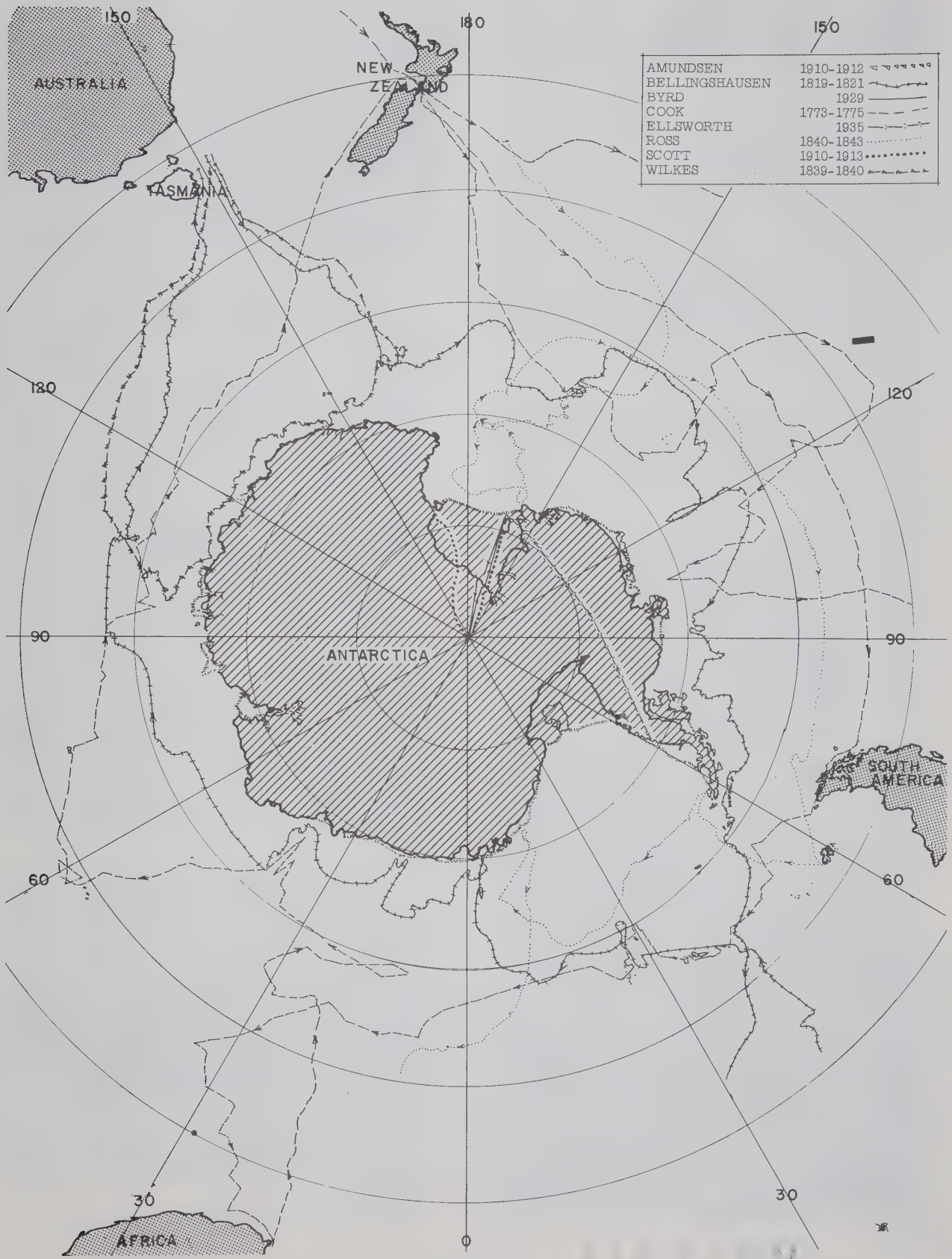
Hallett IGY Station located at Cape Hallett.

Panoramic view of Ellsworth IGY Station in 1957.

Amundsen-Scott South Pole IGY Station in 1959.

United Kingdom's Argentine Islands Base.

USSR's Vostok IGY Station on the polar plateau.


AUSTRALIA
NEW ZEALAND
TASMANIA
ANTARCTICA
SOUTH AMERICA
AFRICA
150
180
120
90
60
30
0
AMUNDSEN 1910-1912
BELLINGSHAUSEN 1819-1821
BYRD 1929
COOK 1773-1775
ELLSWORTH 1935
ROSS 1840-1843
SCOTT 1910-1913
WILKES 1839-1840

Occupation

Scientific achievements are difficult to assess. They cannot be counted or weighed or measured like oranges or butter or cloth. From hundreds and even thousands of observations, the results are put together. They are then checked and rechecked. This process may take years, and more years may go by before there is a practical application of these results. It is, however, interesting to note that United States scientists alone shipped home 27 tons of records during the International Geophysical Year. The scientists of 11 other countries were equally busy.

It will be a long time before all the existing material is filed, catalogued, and studied. Even as the first results began coming in, United States scientists were convinced that the international effort should be continued. When they proposed this to their fellows in other countries, they found that almost all agreed with them. As a result, the International Council of Scientific Unions invited the various countries to continue their International Geophysical Year programs. It also created a Scientific Committee on Antarctic Research, called SCAR for short. In this committee, the scientists from the countries interested in Antarctica meet together to develop further programs.

Two principal things have occurred since the end of the International Geophysical Year. First, certain sciences, like geology and biology, have been added to the international programs, and the nations have agreed that good maps of the entire area should be prepared. Second, some countries have found it necessary to close down some of their stations, because Antarctic operations are expensive.

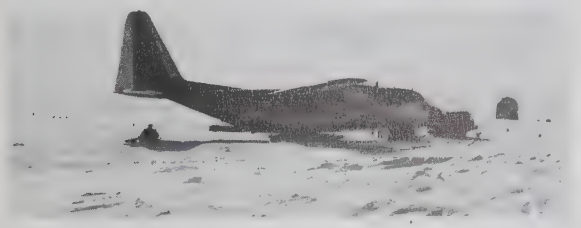
The United States decided to stop operations at Ellsworth, Wilkes, and Little America Stations. It offered to lend the first two to countries that wanted to support the international scientific programs at these locations. Early in 1959, Argentina assumed custody of Ellsworth, and Australia did the same at Wilkes. Little America was placed in stand-by status. The Soviet Union also reduced its program and arranged to transfer one station to Poland. The Poles, however, have not been able to ocuppy the base permanently. During the 1959-1960 season, South Africa took over the Norwegian Station. Norway was not the only country to withdraw from the Antarctic. In 1961, the Belgians suspended operations, as did the Japanese in 1962. Scientists in both these countries hoped to return to Antarctica in the near future, and, in 1963, the Belgians, with assistance from their neighbors, the Dutch, succeeded in doing so.

When the United States closed Little America, it moved some of the scientific programs to what had originally been called the Naval Air Facility, McMurdo Sound. With the expansion of the scientific work at this location it was thought advisable to change the name to McMurdo Station. During the 1961-1962 season, the United States established a temporary summer station called Sky-Hi at 75° 14' South, 77° 10' West, and the following year built a permanent year-around station at this same site. The new station was named Eights after James Eights who in 1829-1830 had been the first United States scientist to visit Antarctica.

The Soviet Union, although reducing its program somewhat, has opened two new stations, one called Novolazarevskaya at 70° 46' South, 11° 49' East and the other, Molodeznaya, at 67° 48' South, 46° 00' East. Argentina, during the 1960-1961 season, also established a new station, Teniente Matienzo at 64° 58' South, 60° 03' West. The Argentines, however, have closed down their stations on the west side of the Antarctic Peninsula and in December 1962, withdrew from Ellsworth.

One of the big problems for men in the Antarctic has always been that of obtaining enough fuel for heat and electric power. Fuel has to be brought over great distances by ship and for that reason is very expensive. Fuel is the largest single item in the shipping of all expeditions. At McMurdo Station the United States installed a nuclear power plant which started operation in 1962. It will cause important savings in the amount of fuel needed. With sufficient heat and power, it will be possible to do many things unknown in the past. Already the United States has started to construct a plant to distill sea water and to use electric rather than oil heaters.

There has occurred a steady improvement in equipment and techniques. Very important was the introduction of ski-equipped C-130 Hercules cargo aircraft beginning in 1960. These airplanes, which can land on almost any level spot in the area, have been used to supply the inland stations, including the delivery of all the materials for building Sky-Hi and Eights Stations, and to place scientific parties in the field. Together with other types of aircraft, they have made great changes in the pattern of exploration. Formerly, men came to the Antarctic by ship and remained over the winter in order to get a full season in the field. This meant a scientist remained away from his classroom or laboratory for 18 months. Now, however, these same persons may fly to the Antarctic in October, be delivered to the field by airplane, and at the end of the season be picked up and returned to the United States. What used to require 18 months, can now be accomplished in 3 or 4.



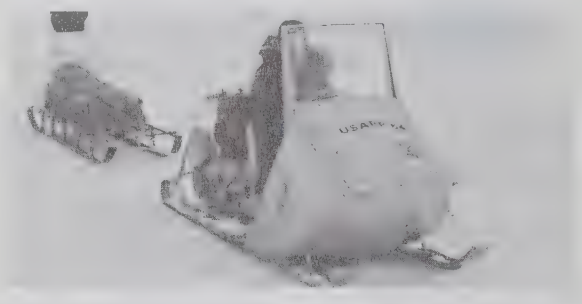
Ski-equipped Hercules C-130 aircraft at the Pole.

Other nations have followed the same pattern, but none to the same extent as the United States. Early in the 1961 season and again in 1963, two Russian aircraft landed at McMurdo Station on a trip from the Soviet Union to Mirnyy Station by way of Australia and New Zealand. At the end of the season, they returned home flying directly from Mirnyy to New Zealand. A few days after the Russians first visited McMurdo, two Argentine airplanes arrived at the South Pole, having flown from southern Argentina to Teniente Matienzo then on to Ellsworth and the South Pole. They went back the way they had come.

Soviet IL-18 landing at McMurdo Station in 1963.

At the end of September 1963, two LC-130F aircraft of the United States Navy left Capetown, South Africa, and about 14 1/2 hours later, landed at McMurdo Station, after flying over the South Pole. This flight, like one made in 1962 from McMurdo Sound to Punta Arenas, near the tip of South America, showed that trans-Antarctic flights are not only possible but practically feasible in the summer season. Toward the end of June 1964, during the dead of the winter night, another LC-130F landed and took-off from McMurdo Station. It was on a mercy mission to rescue a severely injured sailor, but its success indicated that not even total darkness is an insurmountable barrier to aerial navigation.

In the field itself, improved equipment has appeared. Notable has been the motor tobbogan, a small light vehicle, capable of hauling a couple of 1,000 pound sleds. Scientists like them because they are simple to operate and care for, are easily carried by airplane, and use little fuel. They are almost like a mechanical dog team.



Above: "Sno-Traveler" motor toboggan, the "mechanical dog team of the modern scientist.
Below: Gasoline powered sled brought to the Antarctic by Scott on his last expedition.

Even more recently, turbo-powered helicopters, capable of operating at altitudes up to 16,000 feet have been used in the Antarctic by United States scientists, first for topographic surveying and, during the 1963 - 1964 season, for geological survey work. Use of this highly efficient aircraft saves many weeks of labor consumed in utilization of ground transportation and enables the scientist to accomplish in one short Antarctic summer what formerly would have taken several.

Above: Two HU-1B Iroquis in flight.
Below: Field survey camp; note HU-1B at left.

With all these changes, summer scientific work has increased in importance. Slowly, men are investigating all parts of Antarctica, and each year the unseen, unknown area grows smaller. For example, in February 1964, a United States Navy plane on a reconnaissance flight over Queen Maud Land, which lies on the opposite side of the South Pole from McMurdo Station, discovered a new range of mountains and received indications on the radar that other ranges lay just over the horizon. It will not be too long before all the continent will have been mapped. It will, however, be a very long time before all of the continent is thoroughly studied. Men have many decades of work still to do in the frozen south.

New mountain range sited in DEEP FREEZE 64.

Before the International Geophysical Year, seven nations had claimed parts of Antarctica for themselves. They were Argentina, Australia, Britain, Chile, France, New Zealand, and Norway. The claims of Argentina, Britain, and Chile overlap one another in the Antarctic Peninsula area, and this situation has caused some friction in the past. The other nations participating in the International Geophysical Year have made no claims to territory. United States policy has been, while making no claims itself, not to recognize the claims of others and to reserve its right to put forward a claim or claims based on the activities of citizens beginning with Palmer in 1820.

The cooperation during the International Geophysical Year, both in scientific programs and in coming to one another's help, made a great impression on men everywhere. The representatives of the 12 nations active in Antarctica met in Washington, D.C. at the invitation of the United States to discuss the future of the area. On December 1, 1959, they signed a treaty stating that the Antarctic would be open to all for peaceful purposes, and they pledged themselves to exchange information including the results of scientific activities. In doing this, they carried out Admiral Byrd's dream that Antarctica would remain a great white continent of peace.

The treaty will last for 30 years and may be renewed indefinitely. It would seem that the countries which signed it intended, if possible, to stay. Permanent occupancy has thus come to the continent. This idea, first proposed by the United States in 1939 and begun in a small way around the Antarctic Peninsula by Argentina, Britain, and Chile after World War II, is now a reality.

During the International Geophysical Year, scientists learned much new about what occurs in the atmosphere when the sunspot cycle reaches a maximum. With the continuation of international cooperation, even though it was on a reduced scale, they continued to follow these phenomena. As the cycle approached its minimum, it appeared to be desirable to put forward another intensive effort comparable to that of the International Geophysical Year. The scientists, therefore, organized what they called the International Years of the Quiet Sun to take place in 1964 and 1965. Because of the advantages of Antarctica for the study of the upper atmosphere, the Antarctic had an important part in their plans.

Living in the Antarctic

Today, men can live comfortably in the Antarctic if they stay near their bases. Life in these small communities and on the trail has improved since the days of Amundsen and Scott, but it is still rugged by ordinary standards.

One obvious problem is that almost everything needed to live in the Antarctic must be brought from the outside. Except along the seacoast, where seals and penguins and other birds may be found, there are no animals man may kill for food. There are no plants from which to pluck berries to eat. If food runs out, there is no corner grocery where it may be replenished. When a machine breaks down, it cannot be taken to a repair station. It must be fixed on the spot with what is available. The doctor who uses up his medicine cannot obtain more from a nearby drugstore. Once the last ships and airplanes pull out in March, the best equipped expedition is on its own until the aircraft return the following October. The ships usually do not come back before December.

Perhaps the greatest single danger to an Antarctic station is fire. Fire can destroy the buildings men need for shelter and burn up the supplies they need for food. For that reason, an Antarctic station usually consists of several buildings scattered about. Supplies are stored where they will not catch fire if a building burns, and it is customary to furnish a base with enough supplies for two or more years. At many bases, there is a refuge hut some distance from the main living quarters. This hut is stocked with food and other necessities. If the main living quarters are destroyed, the men can go to the refuge hut. They would be terribly crowded, and they would have to ration their food carefully, but they would be able to survive until a ship or plane came to their rescue.

Fire at McMurdo Station in January of 1961.

In fighting fire, the men use chemical fire extinguishers because there is no water. During the summer months, there may be some melt water along the coast, but during the greater part of the year, and at all seasons in the interior, all the water of Antarctica is frozen into snow and ice. To be used for drinking or washing, it has to be melted. This melting requires fuel that has to be brought from outside.

On small early expeditions, water was a scarce and precious thing. Men used it very carefully. Even today it is expensive, because it takes great effort to get it. Men have to go outside in the cold and dark to dig snow, load it on sleds, and haul it to their buildings. In early days, this was done by hand. Today, at United States stations, tractors are used. Sometimes the men cannot go out because of blizzards; then the water supply runs short. Also, it can get so cold that men cannot work outdoors for more than a few minutes without damaging their lungs. This happened at our South Pole Station, but the men found another way to get water. They made a shaft, like a mine, underneath the camp. There they dug out ice and carried it up to their snow melters. Men in other climates have frequently dug holes in the ground to get water, but those at the South Pole are the first ones to mine it like coal or iron ore. At McMurdo Station, however, there is a scarcity of pure snow available for melting purposes and thus construction has begun on a new sea-water distillation plant which, it is hoped, will supply all of that base's needs in the future.

Right: Snow being carried to snowmelters.

Left: Snow mine at Amundsen-Scott South Pole.

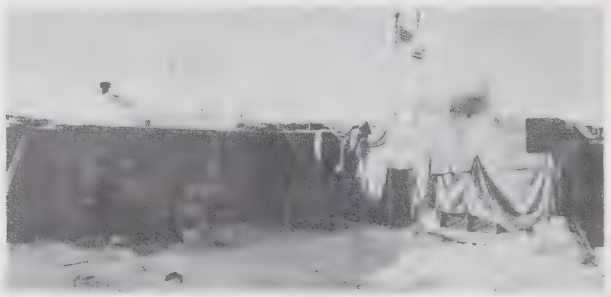
Bases in the Antarctic are of two general kinds according to location. There are those like Hallett and McMurdo Stations which are built along the coast at places where the snow melts off in the Antarctic summer. They have foundations on rock or permanently frozen ground. While some special techniques are required when building on frozen ground, the problems are not really different from those encountered in parts of Alaska and northern Canada.

Other bases, however, are set up on the polar plateau or on ice shelves such as Amundsen-Scott South Pole Station or Little America V. At such places, the buildings were constructed on the surface and connected by passageways made of two-by-fours over which chickenwire and burlap were stretched. The snow drifted over these passageways and turned them into tunnels along which the men could store their food and supplies where they could get at them in the worst possible weather. This type of construction served very well for expeditions that remained one or two years. With permanent occupancy, it was found, however, that the snow continued to pile up until the whole station was crushed.

Snow accumulation damage at Byrd IGY Station.

Side view of an iceberg showing a cross-section of Little America III. This berg is part of the Ross Ice Shelf. Note snow accumulation.

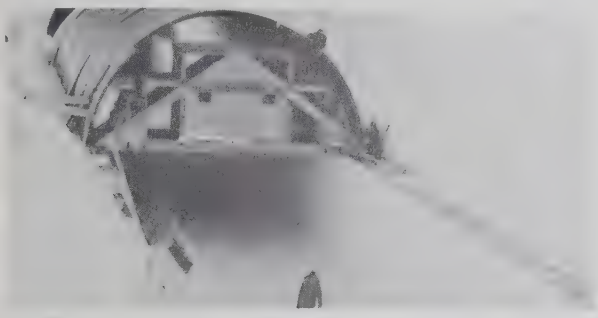
This problem of drifting snow has led to the abandonment of many stations. It was one of the reasons for the Argentines closing Ellsworth and the United States not maintaining Little America V. The rate at which the snow accumulates varies from place to place with the different climatic conditions. In 1929, Admiral Byrd set up a 75-foot radio tower at the Bay of Whales. Thirty years later to the month, only four feet remained above the surface. At the Russian station of Vostok, there has been virtually no snow accumulation in eight years.



Amundsen-Scott South Pole Station in 1958 showchickenwire and burlap construction.

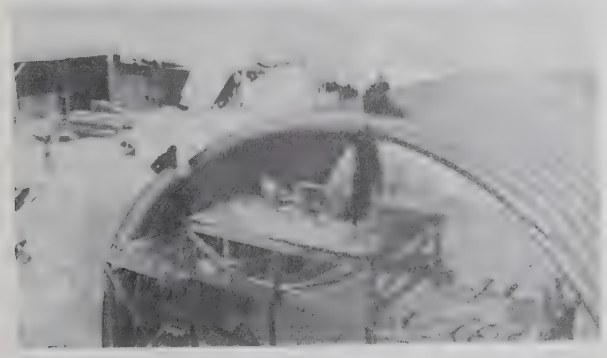
To solve this problem, some expeditions dug trenches in which to place their buildings. They hoped that the snow would level off and not continue to accumulate. The United States Army adopted an elaborate form of this technique at Camp Century on the Greenland Icecap. When the original Byrd Station threatened to collapse, the Navy copied this type of construction in building a new one. Trenches are first dug, then arched over and snow blown back across the arches to create a level surface. Standard type polar buildings are then placed in the trenches with sufficient space for walking on either side. There is thus created a veritable city under the snow. Such construction is now also being used to rebuild portions of Amundsen-Scott South Pole Station which have began to collapse from the weight of accumulated snow.

Trenches being carved in the snow field by a Peter Sno-Miller for construction of Byrd.



Erection of steel arches to form tunnels in the snow to house prefabricated building types.

Overall view of Byrd Station after completion of construction and backfilling.



View of new construction at Amundsen-Scott South Pole Station using wonder-arch design.

For small stations, trailers, sometimes called wanigans, pulled by tractors have been used. The Soviet Vostok Station, for example, is of this type as is the United States summer station at Little Rockford. As the trailers can be moved, it is possible to relocate them on the surface as snow piles up. A further development of this concept occurred when the United States established Eights Station at the base of the Antarctic Peninsula. The trailers were built to fit in the cargo bay of a C-130 Hercules aircraft and were so made that they could be joined together to form a continuous structure. Each unit was also completely furnished and equipped for its particular function in the base prior to shipment. This type of base is simple to establish in the field, can be moved back to the surface, and, if so desired, can be dismantled and transported by air to another location.

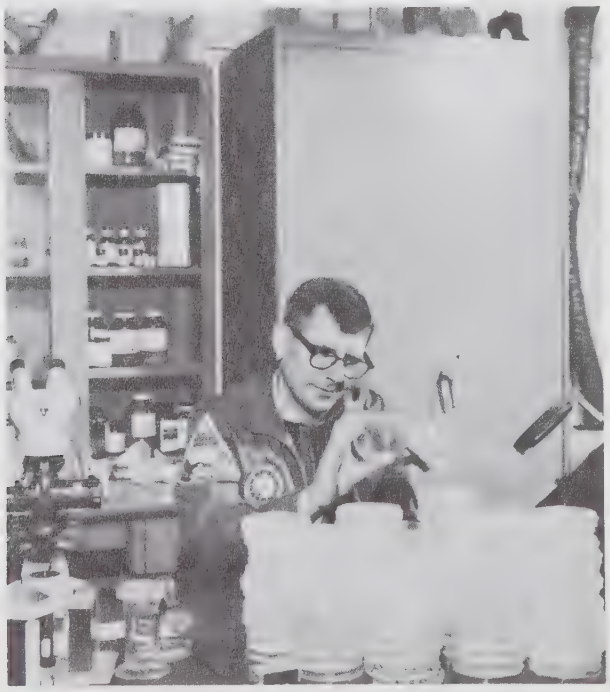
Above: Loading of van-type unit for transporta- to location of new station establishment.
Below: Finished complex of vans at Eights.

It is perhaps an error to think of the Antarctic cold as always harmful. Food placed in tunnels keeps just the way it does in a freezer. Because in most places there is no moisture except in frozen form, metal does not rust and wood does not rot. For the most part, however, the cold creates terrible problems. Even in their huts, early explorers suffered from it. The high winds blew through every crack and drove powdered snow before them.

Today, buildings have greatly improved. Instead of wood and tarpaper shacks, a variety of buildings appear at Antarctic stations. Almost all are prefabricated and are easy to assemble under the most difficult conditions. A common type uses panels for sides and roofs. These

panels consist of a layer of plywood which faces outside, and a layer of aluminum, or other light metal, which faces inside. Between the two layers is an insulating material which helps to keep the heat in. The panels come in standard sizes that fit tightly together. They can be put up quickly in buildings of many different sorts. When completed, such buildings are almost air-tight and easy to heat.

Interior view of Shackleton's hut at Cape Royds shown above. In contrast is the modern scientific laboratory at McMurdo shown below.



Prefabricated building erection similar to the technique utilized in the Antarctic.

As long as expeditions have among their purposes to explore and study Antarctica, men cannot always stay at their stations. They must go out on the trail, carrying on sleds everything they need—tents, sleeping bags, food, clothing, fuel, and scientific instruments. In the days before tractors, this was very difficult to do. Many early explorers hitched themselves to their sleds and trudged slowly and painfully over the Antarctic landscape. Others tried to use Siberian ponies, but these little beasts were not well-adapted to the Antarctic. Much more successful were the sled dogs or Huskies like those used by the Eskimos. Amundsen's great achievement in reaching the South Pole in 1911 was based on his intelligent use of Huskies. Although many expeditions now have tractors and airplanes to get about, few of them are without sled dogs. During Operation DEEP FREEZE II, a team of Huskies was flown to the South Pole itself in a Navy plane. They proved most useful when the tractor broke down.

Dog team and C-130 Hercules "on the ice".

On his 1901-1904 expedition, Captain Scott took an observation balloon to the Antarctic. Letting the balloon up on a cable from his ship, Captain Scott used it to make observations of the Ross Ice Shelf. It was not until Sir Hubert Wilkins' 1928 flight that the airplane was introduced to the area. Early in 1929, Admiral Byrd began using airplanes and aerial cameras extensively in exploration. Not only did he fly over large areas, but, also, he landed parties in the field and picked them up again. An airplane with skiis

in place of wheels can land all over Antarctica wherever there is a flat, smooth place. We have seen how Lincoln Ellsworth crossed the continent from the tip of the Antarctic Peninsula to the Ross Sea, coming down when he encountered storms or wanted to take an observation to fix his position. Improved methods of aerial photography have made it possible to explore and map large areas of Antarctica that would be nearly impossible to reach on the surface.

As we have seen, the Air Force and Navy planes made it possible to build a scientific station at the South Pole itself. The United States and Russia have also used planes to keep stations far inland on the plateau supplied with food, fuel, and other necessities. It seems probable that within a few years all the remaining unknown parts of the continent will have been seen from the air.

At first, big airplanes like those required to carry supplies to the South Pole presented a new problem to the Antarctic. They weighed too much to use skiis and had to land on wheels. In December 1955, the Navy landed wheeled planes on the bay ice at McMurdo Sound. For Operation DEEP FREEZE II, when the still larger Air Force planes were expected, the snow was cleared from the ice and a runway laid out. This worked successfully, except that, as the weather grew warmer, the runway began to melt and it developed holes filled with water. It looked for a time as if the South Pole station would have to operate without all its men and supplies. In this emergency, the Army rushed a civilian expert in the study of ice and its behavior all the way from the United States. After looking over the situation, he filled the holes with a mixture of ice chips, snow, and water that froze solid. This "ice concrete," as he called it, saved the day and the operation went on again. The new C-130s, because they can land on the snow of ice shelves or the polar plateau, would not have undergone this danger.

Many important scientific studies, however, can only be made on the surface. To carry these out, men must travel on foot or by dog team and tractor train. The first motor vehicle, an automobile with skiis in place of front wheels, was brought to the Antarctic by Shackleton in 1907. It could run over the smooth bay ice of McMurdo Sound but was not much use anywhere else. Even as late as 1929 and 1930, the first Byrd Antarctic Expedition depended upon dogs as the principal means of overland transport.

Within a few years, a notable change occurred. The second Byrd Antarctic Expedition (1933-1935) took to Little America a number of tractors, including some originally designed for crossing the Sahara Desert. These vehicles turned out to be both useful and reliable. Since that time, large expeditions have been equipped with tractors and other vehicles. Today, the men on Operation DEEP FREEZE have several kinds that they use for different types of work about their stations and on long trips.

Above: Heavy tractor trains move toward Byrd IGY Station in 1957.
Below: Motor toboggan pulling two sleds.

The most dramatic way in which these vehicles are used is in tractor trains. A tractor pulls behind it one or more sleds on which supplies and equipment are loaded. The tractor trains that carried the building supplies, food, and equipment to Byrd Station in 1956 and 1957 used 35-ton tractors and sleds that, when loaded, weighed 20 tons. When the men ate or slept, they used wanigans. A wanigan is really a hut built on a sled that can be pulled along behind a tractor. It contains bunks, stoves, radio equipment, and other things to make the men comfortable. To Captain Scott and his companions, it would seem like a great luxury.

Antarctic travel, however, remains difficult and dangerous. Great blizzards blow up quickly and last for days, bringing the mightiest tractor to a halt. Then there is always the danger that a tractor will fall into a crevasse. A crevasse is a crack in the ice. It may be from a few inches to many feet wide and over 100 feet deep. Crevasses are particularly numerous where the ice spills down from the polar plateau to form the great ice shelves that surround much of the coast. They would not be so bad it the traveler could see them, but often he cannot. The blowing snow forms bridges over the top, and, if much weight is applied, these bridges give way.

Traverse equipment after a blizzard on the polar plateau in 1963.

Even in the day of travel with man-hauled and dog-drawn sleds, crevasses were a terror to explorers. On one occasion, a man fell into a crevasse and wedged upside down between two ice ledges. He hung in this uncomfortable position halfway down a crevasse for many hours before his companions rescued him. The great Australian explorer, Sir Douglas Mawson, was hauling his sled alone when he broke through a snow bridge. He was saved only because his sled stuck at the edge of the crevasse, leaving him dangling by his harness. With the utmost difficulty, he managed to pull himself up, and went on.

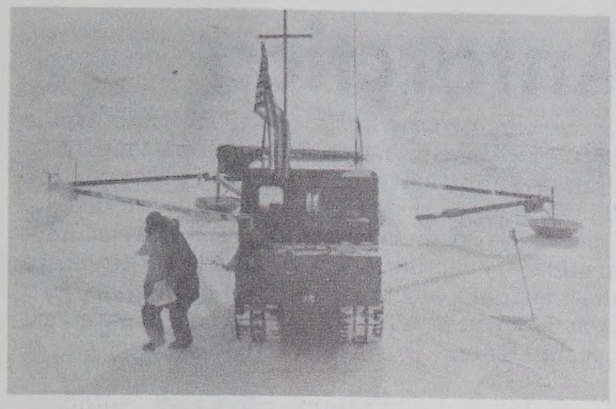
D-8 Caterpillar tractor in crevasse.

Open crevasse on the trail from Little America V to Byrd IGY Station.

Today, tractors have extra-wide tracks so that they will spread their weight over a greater surface area. Even then, they may slip into a crevasse as one did during Operation DEEP FREEZE I (1955-1956) carrying its driver to his death.

The next year, the Navy planned to transport the material for Byrd Station by tractor train. The route of over 600 miles passed through crevassed areas. One especially bad place was where the ice fell from the plateau to the Ross Sea. Unless the tractors could get across the crevassed area, the United States would have to give up one of its most important scientific stations.

Open end of hidden crevasse. Note the forma- of the snow bridge at the top which hides danger.



Electronic crevasse detector at work.

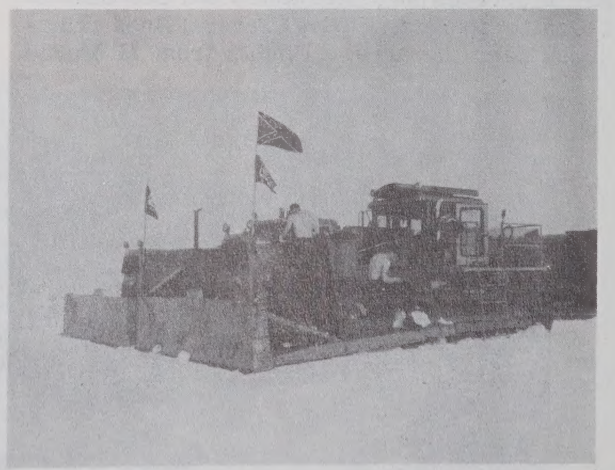
This was the reason the Navy asked for help from the Army's Greenland experts. These Army men formed part of an advance trail party that went ahead of the heavy tractor trains to find a safe route. They had with them a device which detected crevasses electrically. Where crevasses were few in number, they steered around them, but finally the party came to a place where the crevasses were everywhere. There was only one thing to do—blast the crevasses open and fill them with snow. For two weeks the advance trail party inched its way forward across a maze of crevasses over seven miles wide, blasting and filling as it went. At last it climbed out to the comparative safety of the plateau, and its leader radioed back to Little America that the heavy tractor train could start its journey.

You may wonder what kind of clothing men wear outdoors in the Antarctic. Is it very heavy, for example? Actually on a still day, when the sun is shining, men working outside become warm. Frequently, they strip down to their shirt sleeves. Hardy souls have even been known to take their shirts off and run the risk of being badly sunburned. Ordinarily, however, Antarctic explorers dress warmly. The principle of cold weather clothing is not so much the bulk of the individual pieces as it is the number of layers. Between each layer air is trapped, and this air serves as insulation. Another important feature of Antarctic clothing is that the outer layers should be windproof.

With present-day clothing and equipment, men can live in the Antarctic quite comfortably. They can even live and work on the trail at very low temperatures. The Antarctic, however, remains a dangerous and unpredictable land. Men,

View showing types of clothing worn in the Ant- to keep the men warm.

if they are going to survive there, must never relax their guard. A moment of carelessness can easily cost a life.



Acclimatized mechanics work bare-backed.

The Future of Antarctica

It is less than two centuries since James Cook first sailed around the Antarctic Continent. At that time he wrongly prophecied that its discovery would be of no benefit to mankind. A little over 140 years ago, the sealers arrived and, in a few years, after having nearly exterminated the fur seals, departed. Whaling is probably a declining industry, as those great beasts become scarcer and more difficult to find.

Today, of course, the principal exports of Antarctica are scientific records, the value of which cannot be expressed in dollars. The scientists, however, are convinced that what they learn is worth the expenditure of money, time, and effort. The future of Antarctica as a base for scientific studies seems assured. Explorer-scientists will be going south for a long time to come.

Do other uses for Antarctica exist? Every year in Europe thousands of people journey to the northern tip of Norway to see the midnight sun. Why not travel south by ship or airplane during the southern summer to see the same thing at the other end of the world? A few years ago, the Argentines sent a tourist ship to the tip of the Antarctic Peninsula. Other people have dreamed of resort hotels to which aircraft might fly. There are many problems, but they probably could be solved. Such a resort would, however, be very expensive so that, to make it pay, would require high rates.

In 1954, the first airline service over the Arctic between the United States and Scandinavia began to operate. Today, several lines criss-cross over the area. Flights from McMurdo Sound to southern Chile and from South Africa to McMurdo Sound have already shown that flying across Antarctica is practicable. Perhaps in the future, we will have air service between the nations of the Southern Hemisphere by way of Antarctica. Then, there would have to be alternate landing fields, electronic aids to navigation, and other facilities with the people to maintain and operate them.

Antarctica has natural resources, although we do not now know their full nature and extent. Even if we were certain of their richness, it would not now be economic to develop them. It would simply cost too much. Industrial societies, however, use resources at a rapid rate, and industry is spreading throughout the world. As resources are used up in more temperate climates, men may someday turn to the Antarctic for what they need, especially if they can develop better technical means for living and working in the area.

This is not impossible. Just compare the sailing ships of Nat Palmer's day with a modern icebreaker, or Scott and his companions pulling their sleds with a present-day tractor train. In 1929, Admiral Byrd took about 10 hours to fly to the South Pole; now a C-130, flying a longer route, does it in 3. Improvements in technology are not going to stop. The nuclear reactor at McMurdo Station is a symbol of the future.

It is perhaps too early to think of communities complete with school, churches, and stores, but if man can plan to go to the moon, he may also dream of taming the Antarctic.